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THE INDIAN ACADEMY OF SCIENCES*

THE first annual meeting of the Indian Academy of Sciences was held at Bombay. Once again we meet in the Bombay Presidency, this time in the historic city of Poona, asscciated in our minds with one of the most striking periods in Indian history and to-day one of the chief centres of culture and learning in our country. To our hosts who have taken it upon themselves in these difficult times to invite us to their city and thereby made it possible for us to meet here, our grateful thanks are due.

Ten years is not a long period in the life of an individual, much less in the history of an institution. Infantile mortality is, however, notoriously high in India. Hence, it is not inappropriate for me to draw your attention to the fact that this is our tenth annual meeting and that the scientific *Proceedings* of the Academy are now running in the twentieth volume, both in the A and B series. The usefulness of these *Proceedings* as a forum for the publication to the world of the results of the scientific investigations of our Fellows and their collaborators has been abundantly demonstrated. The *Proceedings* have appeared in an unbroken sequence and with unfailing punctuality on the last day of every month ever since July 1934 which was the date of the first issue. This is a record of which we may feel justifiably proud.

The Academy is a body of scientific men interested in their work and especially in the advancement of knowledge by original research. It is an organisation which can be of immense service to science and to the country in various ways, if it is adequately supported and encouraged. I think I am speaking for all our Fellows throughout India when I say that not only are we capable of rendering such service, but are also willing to do everything in our power to demonstrate the social value of scientific research in our country. Elsewhere in the world, the Academies of Science are not merely publishing organisations for scientific research, but also function as active promoters of scientific research by building and equipping laboratories and maintaining professors and students to work in them. It is my considered opinion that the future of science in India depends to a very great extent on such a development taking place in our country and not upon the multiplication of official laboratories staffed by armies of Government servants. The history of science has demonstrated over and over again that the choicest fruits of scientific research fall into the hands of those men who seek for no reward except the discovery of truth. The mind that seeks to explore Nature and discover her secrets and the mind of a bureaucrat are as poles asunder.

It is my earnest desire that the Indian Academy of Sciences should function in the manner I have indicated and actively sponsor scientific research in a group of institutions covering the whole field of natural knowledge, from pure mathematics and astronomy at one end, physics, chemistry and mineralogy in the middle and physiology and genetics at the

* Part I of the Presidential Address by Sir C. V. Raman at the Poona Meeting, 27th December 1944.

other end. Such a group of institutions linked together and working under the general guidance of the Academy would serve as the vanguard of science in India, marching into the unknown, blazing a trail for others to follow and pointing a way to the practical applications of science. Such a scheme may seem a colossal one, but to my mind it is entirely practical and indeed realisable in a reasonably short time, if only our wealthy men could give a generous helping hand. Nothing would pleace me more than to be able to devote myself to the realisation of this idea and of its practical consequences.

Meanwhile, there is one small step which our Fellows, if they so choose can help the Academy to take immediately, and that is to provide a permanent habitation for our offices. A circular letter has been issued to our Fellows in this connection, and I greatly hope that it will meet with an immediate and generous response from them.

* * *

I shall devote the rest of this address to a topic which is surely familiar to you all. Who does not know the classic illustration of the thermal expansion of solids which is the fitting of the iron tyre to a cart-wheel by first heating it up and then placing it in position? To know that a solid expands when heated is, however, only a first step in knowledge. To specify its magnitude and offer an explanation of the phenomenon and to predict its course over a wide range of temperature are the deeper problems of the subject.

The solids familiar to us in our daily lives are of complex structure and their thermal behaviour is naturally of great practical importance. But to the physicist who seeks to understand the fundamental aspects of the subject, the ideal materials to study are those which are relatively simple, both physically and chemically. The best choice is that of a well-developed single crystal, while such substances as pure metals, diamond, rock-salt, flourspar, calcite and quartz offer the greatest promise of a successful theoretical interpretation.

It is easy enough to observe and measure the expansion of a long bar when heated up sufficiently. When we are working with single crystals, however, it is usually possible only to get rather small specimens. The accurate determination of thermal expansion then becomes a more difficult experimental problem. The celebrated French Physicist, Fizeau, was the first to use the delicate optical method known as the interference of light for such studies. For this purpose, he worked with specially cut and polished specimens of various crystals. During a visit to Paris in the year 1937, I was fortunately enabled to discover and purchase several of Fizeau's original specimens. The collection now forms one of the most highly prized treasures in my crystal cabinet.

Another and very beautiful method which is extensively used at the present time is based on the use of X-rays. The angle at which such rays are reflected by the atomic layers in a crystal depends on the spacing of these layers, and alters with the changes of spacing produced by the expansion or contraction of the crystal. Very small quantities of the substance are sufficient for this method, and it is also possible to use material in the form of powder. Further, by choosing the conditions such that the X-rays are reflected almost exactly backwards, very small changes in the atomic spacing produce a detectable change in the angle of reflection. The method is then both sensitive and accurate. An important aspect of the technique of the X-ray method is the maintenance of the material at the desired temperature without altering the temperature of the rest of the camera. Recently, Dr. R. S. Krishnan has reported an interesting modification in which this difficulty is avoided by the use of a divergent beam of X-rays. The X-rays fall upon a chosen face of the crystal, and the sharply-defined reflections given by it are recorded on a photographic film placed at any desired distance. Even a small expansion then produces an observable shift which can be accurately measured. It is important to hold the crystal in such a way that it does not rotate appreciably when heated or cooled, and this can be controlled by a second photograph in a different setting of the crystal. In this way, Dr. Krishnan has studied the thermal expansion of diamond over a fairly large range of temperatures.

Except in the case of a crystal belonging to the cubic system, its expansion is not the same in all directions, the nature of the differences being determined in a general way by the symmetry of the crystal, and more particularly by its internal architecture. To determine the thermal behaviour of a given crystal completely, it may thus be necessary to determine the expansion in several directions. When it is recalled that the rate of the thermal expansion per degree centigrade itself usually changes with temperature, and that this may again be different for different directions, it will be realised that a complete specification of the thermal behaviour of a crystal of low symmetry over a wide range of temperature may be somewhat complicated. Indeed, some crystals, *e.g.*, calcite, actually contract instead of expanding in certain directions when heated. It is a special advantage of the X-ray method in which powders are used is that the changes in all the atomic spacings of the crystal lying in many different planes are simultaneously recorded, thereby reducing the labour involved in the study of a particular substance.

As already remarked, the thermal expansion of a solid per degree centigrade is far from being constant over any appreciable range of temperature. The changes in the rate of expansion are particularly striking at low temperatures such as those of liquid-air. There are, however, some crystals in which the accelerated thermal expansion is noticeable even at and above room temperature. Diamond is a particularly conspicuous example, as is shown by Dr. Krishnan's recent studies with it.

BASIC PRINCIPLES FOR PLANNING THE DEVELOPMENT OF INDIAN FRESH-WATER FISHERIES

BY

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THE acute shortage of meat and other animal food of all kinds caused chiefly by the unprecedented demand made by the War and the consequent 'Grow More Food' Campaign has brought to prominence the much neglected fishing industry as a source of food supply. The urgent need to develop the industry has begun to receive the attention of the authorities concerned. Both independently and recently at the instance of the Government of India, provincial and State Governments have set themselves to the task of actively planning the development of their inland fisheries with the twofold object of (1) immediate exploitation to meet the present demand and (2) organizing it on scientific lines as a post-war national food industry.

For planning the development of Indian Fisheries on sound scientific lines, expert advice is essential. The Indian fishing industry is primitive and in the hands of a poor and illiterate caste, cannot provide leading businessmen such as are available in more advanced countries, who could be consulted for planning development, while scientists with academic qualifications in fisheries science and practical experience are practically absent. The greatest obstacle, therefore, to successful planning in India is the absence of technical advice and guidance.

In every scheme that has come to my notice so far, emphasis is laid on increased production and marketing, but the all-important conservational aspect of development which should precede intensified exploitation if production is to be sustained, is paid little or no attention. Even the Government of India circular letter No. F-8-5/44, dated 26th May 1944, has failed to mention the paramount importance of conservancy operations while it rightly emphasises intensive production by improved fishing, culture and marketing to meet the present demand.

The fresh-water fisheries of India in the strict sense comprise those of:—

(1) Rivers and their tributaries.
(2) Natural lakes, Beels or Jheels.
(3) Canals.
(4) Artificial reservoirs for irrigation, power or flood-protection.
(5) Small irrigation tanks.
(6) Village ponds.

By far the largest and the most important fisheries are those of Nos. (1) to (4). Of these No. (1) is the *primary source* of our best food-fish—Rohu, Katla, Mirgal, Mahseer, Bachua, Tengra, etc., and it is from the rivers chiefly that all other sources are replenished. From the scientific and economic point of view, therefore, the rivers require the first and the most careful attention, if the future of the fisheries is to be safeguarded and their permanent improvement is to be effected.

Plans for Developing Fresh-Water Fisheries

Fisheries unlike Agriculture or Animal Husbandry depend primarily upon exploitation of natural wealth. Fisheries are more akin to forestry inasmuch as we usually reap where we do not sow. In developing fresh-water fisheries, therefore, the technical operations involved may be summarised under three main heads:—

1. Conservation.
2. Culture.
3. Exploitation.

For all three alike, research and investigation are indispensable. This may perhaps be made clear by three simple examples. The conservation of fisheries depends on a precise knowledge of the existing stocks of fish, their breeding grounds, seasons and habits, which is the result of continuous and detailed observation. Likewise pisciculture, which is a highly technical fishery operation, involves an intimate knowledge of the breeding habits, eggs and early stages of growth of each fish, for which again patient study, accurate observation and delicate manipulation are essential to success. Even for exploitation and marketing from capture to the finished product on the market, biological, chemical and industrial research is needed at every stage.

1. *Conservation.*—The rivers being the primary source of our chief food-fish their conservation should receive the immediate attention in any plan of development, specially as exploitation has been intensified without any reference to the capacity of our rivers. To cite one example which as Fishery Development Officer in the U.P., I had occasion to investigate this summer: From a small section of the Ganges between Allahabad and Benares, "about 150 miles" over 1,000 maunds of fish were being exported every month, over and above some 3,000 maunds sold locally in Allahabad and a similar quantity in Benares. If fish caught in intermediate towns along the river is also taken into account, 10,000 maunds a month is a conservative figure for this stretch of the river. The U.P. Government, at my instance, placed a ban on the export as we had no precise knowledge of the stock of fish in the river or of its productivity, and 10,000 maunds was a strain on any stretch of river, specially as only deep pools existed here and there in the hot weather and these were netted to extinction by contractors who were profiteering on the great disparity in prices prevailing in the U.P., Bombay and Calcutta markets. Their production cost was found to be Rs. 8 a maund at Allahabad as against a sale price of Rs. 80 per maund in Calcutta and Bombay. At present we have no machinery by which to assess the exact effects of this intensified exploitation on the rivers which are our primary source of fish. It is, therefore, the duty of

those who undertake planning to provide an adequate machinery for the all-important task of assessing the stocks and the productive capacity of the rivers. Fisheries science in recent years has made rapid advances. Biometrical, statistical as well as other special methods have been evolved by fisheries science for the elucidation of what may have been considered insoluble problems before, such as the estimation of the stock of fish even in the open sea. The task of estimating the stock in rivers and ascertaining their increase or decrease from time to time should not present insurmountable difficulties. An adequate machinery for such a task utilising all the available technique of the fishery Biologist should form an integral part of scientific fishery organizations to be set up in the Provinces and States. The U.P. plan, therefore, provides a field organization of observers to collect and compile data, a qualified headquarters Laboratory and staff to study this material continuously, draw conclusions and formulate measures, and a preventive staff to carry such measures into execution. The conservancy measures usually adopted are:—

(1) Restriction of mesh of nets and other approved methods of capture.
(2) Prohibition of wholesale destruction by poisoning or dynamite, etc.
(3) Prohibition of capture of young fish or breeding fish generally.
(4) Closure of sections of rivers constituted as sanctuaries throughout or for a part of the year.

The choice and application of any of these except No. (2) will depend on local conditions.

2. *Culture.*—Conservation of the natural resources by itself, is insufficient for maximum fish production. Cultural methods, breeding, rearing, stocking, etc., throughout the agency of fish farms are necessary to supplement nature, specially when intensive exploitation is contemplated. Stocking is particularly required for tanks and land-locked waters which are likely to be completely fished out. Since rivers are the primary source of supply of indigenous fish, their exploitation beyond the limit of natural recovery must always be watched and prevented. On the other hand, tanks and other land-locked waters can be completely fished as the supply can be replenished by stocking. Even where tanks are fed by river channels, an adequate number of fry of suitable food-fish rarely reaches the tanks annually, while invariably predaceous fish obtain access to the tank. Eliminating predaceous varieties and ensuring an adequate supply of fry of food-fish manuring, correcting defects in soil and water and providing an abundant supply of weeds and other food for fish, are the necessary cultural operations if the tanks are to be made to yield their full quota of fish.

Fish culture is perhaps the most technical and specialised of fishery operations. Experience has shown that the spawn and fry of indigenous food-fish can be obtained in sufficiently large numbers from suitable areas in the rivers. It is well known that fish are prolific; a million eggs or more are produced by one breeder (carp specially) at one time. This is nature's provision to counteract destruction by numerous enemies and by an adverse environment. Under natural conditions, only a small proportion of the eggs hatch and a much smaller number of the fry survive. If advantage is taken of this abundance of eggs and fry during the breeding season and they are secured and reared in specially designed ponds and stocked in tanks and Jheels much of the natural wastage in the rivers can be prevented, while the high cost of artificial fecundation and hatching of eggs in expensive hatcheries, is at the same time avoided. For the indigenous fish Rohu, Katla, Mirgal, etc., therefore, all that is needed is to provide nursery ponds in suitable places along the rivers, collect the spawn or fry from the river at the proper time and rear them to the fingerling stage for a few weeks and distribute them to tanks and Jheels after these receive their annual supply of water.

Besides indigenous fish, new and improved varieties of food fish have been introduced and have proved of great advantage in Ceylon, Madras and elsewhere. It is perhaps not very well known that even rainbow trout and brook trout have been grown in ponds. The Mahseer of the Kumaon Hills have been found to breed in land-locked lakes. Another fish which has yielded remarkable results in the Mirror carp, first introduced into Ceylon and recently introduced by me into the Nilgiris. It is a prolific breeder and grows rapidly in ponds and tanks on the hills. The Chinese have probably developed carp culture to perfection. They not only raise carp by intensive feeding with grass and other vegetable matter in ponds, but concurrently raise a subsidiary crop of a different variety of carp which subsists on the fæces of the former variety. This type of intensive culture has been introduced and practised by Chinese settlers in Singapore and should, therefore, be worth trying in India. Gourami is another exotic fish which has given satisfactory results in the South. While it thrives in the tropics up to the latitude of Calcutta or Bombay, it has not been a success further north.

There are also innumerable technical problems varying with the locality, kinds of fish, climate, etc., that require research and investigation before successful piscicultural practice for any Province could be outlined. These investigations relate to the spawning season, breeding habits, character of eggs and fry, rate of growth, the food of the fish at all stages both natural and artificial, the nature of the soil and water and remedial measures for defects in these, suitable weeds and pond-snails and other aquatic life, etc. Besides there are always a number of miscellaneous problems such as wholesale fish mortality which sometimes occurs, infectious diseases, pollution of water, parasites, etc., which should also receive attention.

To deal adequately with all the above problems a central fish farm for research designed on the latest model is necessary. The choice of the site of a fish farm depends on the availability of spawn in the river—they can only be obtained from a few places which have to be searched for—good soil, abundant flowing water, good communications and sufficient low-lying Government land to avoid cost of

acquisition and excessive expenditure on excavating ponds.

3. *Exploitation.*—It has been shown that river fisheries are of supreme importance to the whole scheme of inland fishery development and, therefore, require to be carefully safeguarded by an adequate conservancy and observation staff. A very large proportion of the fish on the markets I have visited comes from the rivers, giving livelihood to large colonies of river fishermen. The scheme of exploitation, therefore, contemplates bringing these fishermen and their operations under the control of Government. To ensure an adequate supply of fish at reasonable rates in important consuming centres, Government may have to launch schemes of capture and supply at least for the duration of the War. In most Provinces and States Government being the largest owners of fisheries, even after the War, if the local trade is incapable of immediate improvement and co-operative agencies cannot be organized, Government will have to initiate fishing and marketing themselves. It should also be explained here that though the Government are the chief producers there is no intention of supplanting the trader or fishmonger wholesale. A model shop at important centres with fixed prices is all that is proposed to be run by Government to stabilise prices with the attendant reforms in hygiene and cleanliness, etc.

Exploitation involves capture, handling, preservation, transport, disposal of waste and manufacture of by-products, all of which it will be the duty of the marketing staff to develop with the assistance of the technical staff of the fisheries organizations. Experience has shown that a great deal can be done for improving the indigenous catching methods. Flooded rivers and deep and perennial tanks go practically unfished as fishermen generally lack efficient craft and tackle. Proper dressing, adequate refrigeration and rapid transport by motors are other new reforms which have already given satisfactory results with reference to three towns in the U.P. Although there may not be any surplus and nearly all fish will be sold fresh, it is possible to utilise fish offal and waste resulting from the dressing of fish for conversion into manure, meal or oil, while the abundant supply of small fish of the Chilwah type at dams as well as Hilsa might afford facilities for canning on a small scale. Model nets and boats, a refrigeration plant and suitable model apparatus for trying out experiments in canning, curing, smoking, extraction of oil and manufacture of manure and meal have to be provided for in the estimate for the Headquarters technological laboratory.

Conclusion

In conclusion, all the three sets of operations, conservancy, culture and exploitation need specially trained and thoroughly qualified staff. Such staff is not available and will have to be carefully selected and trained for the purpose. Of the three, conservation and culture are highly technical operations and the staff for these operations need specialised and prolonged training under qualified supervision. It should not be so difficult to recruit competent men for exploitation, though fishery technology from methods of capture to the finished product on the market, needs special training which is available at Madras. If the efforts of the Government of India to provide training at Calcutta or Madras should succeed it should help in the training of fishery officers for the Provinces and States. Thus in the course of a year or two the locally trained men for subordinate posts should be available while the superior posts will have to wait the return of foreign-trained men. During the interval there is no alternative to using such men as are available in India for temporarily filling the posts.

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INDIAN SCIENTISTS' DELEGATION ABROAD

IN a message dated Washington, December 11th, *Reuter* announced the arrival in the U.S.A. of the delegation of Indian Scientists after completion of their sojourn in Great Britain. The delegation have thus completed the first part of their itinerary abroad and have before them a eight-week tour of the States under the joint auspices of the Agent-General, the National Research Council and the State Department.

These visits, our readers will remember, were sponsored by the Government of India primarily to enable Indian scientific men to contact their confreres in Great Britain and America and to explore, in a broad and tentative manner, how best such contact and co-operation could be maintained and developed to mutual advantage. The visit to Great Britain is in a way sequel to and a return of the compliment paid by Prof. A. V. Hill who toured India a few months ago. But, it is in no sense a mere courtesy visit having, as it does, certain well-defined objectives. The Indian delegation is headed by Sir S. S. Bhatnagar, the other members being Sir J. C. Ghosh, Prof. M. N. Saha, Prof. S. K. Mitra, Prof. J. N. Mukherjee and Dr. Nazir Ahmed. These names are too well-known, especially to readers of *Current Science*, to need a *Who's who*. A message from London stated that membership of the delegation had been deliberately confined to eminent men of science in India who occupied positions of administrative responsibility.

The activities of the delegation during their stay of about six weeks in Great Britain could only be glanced from the brief messages appearing on and off in the daily press. It makes melancholy reading to learn that even in England, the key press have paid but scant attention to the sayings and doings of the delegates in their midst. Obviously, science is scarcely "Good-copy" for the average newspaper although one must add that war-time conditions are partly responsible for the apparent apathy.

The "high-lights" during what can only

surmise must have been a very crowded programme and which the press recorded were the introduction of the delegates by Sir Henry Dale, President of the Royal Society, to His Majesty who graciously received them; discussions with the members of Parliament interested in Science; several receptions by Government, Civic bodies and academic and learned societies (during one of which, by the way, some historic documents pertaining to the Royal Asiatic Society of Bengal were presented back to the Society through one of the delegates), and a press conference besides many functions of a social nature.

In the absence of fuller details, it would not be fair, even if possible, to comment on the statements and speeches of the members of the delegation cryptic summaries of which have been cabled to this country. It looks as though the members have been individually expressing themselves on subjects which they are specially interested in, rather than the delegation as a body give out its views through one of its members acting as the spokesman of the delegation as a whole—a procedure which is the usual international practice when a body of representative men are on a formal visit outside their own country. The role of science in post-war reconstruction in India, the establishment of a bureau in London to act as a *liaison* body between the two countries in all matters pertaining to or affecting science, recruitment of personnel for Indian research institutions, exchange of students and professors, facilities for training and research for Indian students and technicians in the British Universities and workshops, purchase of scientific instruments and equipment, and, the increasing use of Indian Cotton by the Lancashire Textile Mills, are amongst the diverse topics on which the delegates are reported to have expressed themselves. Even a mere listing of these subjects, by no means exhaustive, is indicative of the many facts of a big problem which the delegation is called upon to handle. And, we have no doubt that the members, every one of whom has close and many-sided contacts with the Indian Scientific World and therefore are in an exceptional position to know of Indian requirements and possibilities, will have voiced the Indian point of view on those subjects with ability and distinction.

Finally, it must not be forgotten that during such visits, the personal contacts made—the reunion of old friends, the formation of new friendships, in short the impact of personalities and ideas—are fruitful of results even more enduring than the formal agreements and conclusions reached. It is for this reason, if for no other, that we must regret that the delegation could not, for want of time, accept the very kind invitation of Ireland to visit that country *en route* to the United States. And, for a full account of these aspects of their visit, we must perforce await the home-coming of the delegation to which we look forward with lively anticipation.

PRESENTATION OF SIR C. R. REDDY NATIONAL PRIZE TO SIR C. V. RAMAN, Kt., F.R.S., N.L.

THE eighteenth Convocation of the Andhra University was held on 18th November 1944 in the Andhra Christian College, Guntur, when His Excellency the Governor of Madras and Chancellor of the University, presided. Two notable events were the award of the Honorary degree of D.Litt. to His Excellency the Hon'ble Sir Arthur Oswald James Hope, G.C.I.E., M.C., and of the Sir Chattamanchi Ramalinga Reddy National Prize in the fist year of its inception to Sir Chandra Sekhara Venkata Raman for eminent merit in Physics. The prize is given each year for eminent merit in either Sciences, or Humanities or Fine Arts by a system of rotation, the cost being met from the interest accruing on the capital sum of a munificent donation given by Sir C. R. Reddy to the Andhra University. Sir Chandra Sekhara Venkata Raman was presented to the Chancellor in suitable terms by Prof. S. Bhagavantam, the University Orator in English. In the course of this oration Prof. Bhagavantam said: "It will take many pages to enumerate the discoveries made by him and the ways in which he has contributed to the advancement of Science. To have discovered new facts is in itself a sign of merit. Sir C. V. Raman has, in addition, discovered a new method of discovery, which is being fruitfully applied all over the world in various fields of research. He has given to Science a new eye with which to explore Nature. Honours have deservedly poured upon him in abundance. The Royal Society of London elected him to its Fellowship in 1924. The British Government conferred a Knighthood in 1929. He received the Nobel Prize for Physics in 1930. Amongst his other Scientific Honours may be mentioned, as specially noteworthy, the Matteuci Medal of Italy, the Hughes Medal of the Royal Society, and the Franklin Medal of America. He has received *Honoris Causa Doctorate* Degrees from nine different Universities. This number, Sir, was eight a month ago. It is now nine and I reliably understand that it will become ten a month hence. It appears to increase more or less at the same rate at which the number of Indian Universities is increasing in recent years. He is an Honorary member of many Learned Societies; and he is the Foundation President of the Indian Academy of Sciences which enjoys a global renown. More than his individual achievements, great as they are, is the glory of having trained a large number of young men, one of whom is an F.R.S., who are making a name for themselves by their creative output and are such inspiring figures in a large number of Universities in India. A Scientist is not a prophet in the astrological sense; I do not know if I am transgressing my bounds by trying to anticipate the verdict of History; but in my humble opinion, Ramanujam and Raman bid fair to be regarded as a Class by themselves and as men who have secured for India a towering place in the Republic of Modern Science."

PLANT NEMATODES, A NEGLECTED SUBJECT IN INDIA

By G. D. BHALERAO, D.Sc. (Lond.)

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ALTHOUGH medical and veterinary helminthology has been receiving attention in this country, the field of plant helminthology still remains comparatively unexplored. The only class of helminths known to affect plants are a few genera of nematodes and these the writer proposes to designate as "Phyto-nematodes". Despite its great economic importance it is highly surprising that this branch of science has so far received very meagre attention in this country. The only available reference in India to this subject are those of Butler (1913 and 1919) who described the eel-worm disease of rice and suggested some means of control. Rafay, Padmanabhan and Khanna (1942) have drawn attention to the injury caused by nematodes to sugarcane seedlings and suggested some measures of control. The writer's attention was drawn to this fascinating branch of science when he received, within the past few years, plant nematodes for identification from a few sources in this country. It would, therefore, appear that this is an opportune moment to stress the importance of the study of such worms in this country, of estimating the extent of the ravages they cause to our agricultral produce and finally of evolving an effective plan for their control and eradication. Although so far only three parasites, *viz.*, *Aquillulina tritici* (Steinbuch, 1799), *A. angusta* (Butler, 1913) and *A. similis* (Cobb, 1893) have been recorded from India, this does not, however, preclude the probability of others being discovered in this country. In order to realise the significance of the subject, reference is here made to some important parasites which, barring the three mentioned above, have not yet been recorded from India. In the case of each parasite the names of the economically important plant-hosts and the symptoms produced in them are given. It is not the intention of the writer to deal fully with each parasite within a compass of such a short article, but he will feel his efforts amply rewarded if he could persuade some workers in this country to take up this important line of investigation. Those desirous of obtaining detailed information on the subject would do well to consult Goodey (1933), which will also lead them to other important references on the subject.

1. *Anguillulina tritici* (Steinbuch, 1799).—This small nematode, affecting wheat and barley plants, is known to occur in India. It induces gall-formations in the ears, which are known as "purples" or "cockles". The gall may be simple or compound. The formation of galls within a flower leads to the atrophy of the flower elements. Infected ears are usually shorter than normal ones, and have their glumes standing wider apart.

2. *A. dipsaci* (Kühn, 1858).—This species affects a larger variety of plants than the previous one. Among the important hosts may be mentioned common beet, sunflower, sweet potato, various grasses, oats, barley, sugarcane, wheat, peas, onions, leek, garlic, hemp, banana, tobacco and potato. In dicotyledonous plants, the worms form simple or confluent galls causing deformation of stem and leaf-tissues. Their seedlings generally show a swelling of the hypocotyl. In monocotyledons, swellings are produced at the base of leaves. Affected plants show stunted growth, twisting and rolling of leaves, as well as unthrifty and unhealthy appearance. The parasite may remain in a quiescent state for about six years.

3. *A. angusta* (Butler, 1913).—This species affects rice plants and was recorded in this country by Butler (1913). This worm is entirely ecto-parasitic in habit. In affected plants, leaves wither, the ears are arrested in development and the grains are shrivelled. The glumes usually contain no grain in the lower part of the ear.

4. *A. radicicola* (Greeff, 1872).—This species affects some grasses, oats, barley and wheat. The worms form galls at the tips of roots. The young plants are killed or the leaves and shoots turn yellow, or are stunted and deformed.

5. *A. similis* (Cobb, 1893).—This parasite is known to affect pineapple, canna, coffee, bamboo, sweet potato, banana and sugarcane. It affects roots and has been recorded from India. The affected plants appear unhealthy. They lack in vigour and show sickly discoloured leaves.

6. *A. pratensis* (de Man, 1881).—This parasite affects oats, beet, cabbage, coffee, carrots, bamboo, strawberry, soya bean, cotton, tomato, lucern, poppy, sugarcane, potato, wheat, maize, etc. It affects roots and has been known to occur in India. The affected plants either die or become stunted in growth. The ears remain small and weak.

7. *Tylenchulus semi-penetrans* Cobb, 1913.—This species affects the roots of the orange and grape fruit trees. In heavily infested tracts the plants are stunted and markedly degenerated.

8. *Heterodera schatii Schmidt*, 1871.—The parasite affects pineapple, spinach, sunflower, cauliflower, cabbage, beet, mustard, some grasses, sugarcane, juar, wheet, maize, oats, soya bean, lucern, alfalfa, pea, hemp, poppy, potato, carrot, etc. It affects roots, where its presence gives rise to "giant cell" formation. The leaves change colour, become flaccid and finally die. On account of the excessive development of lateral roots, the main tap root assumes whiskered appearance.

9. *H. Marioni* (Cornu, 1879).—This parasite has a worldwide distribution in tropical, subtropical and temperate regions and affects a very wide range of plants. The chief among these are canna, papaw, sunflower, lettuce, sweet potato, mustard, turnip, radish, watermelon, cucumber, pumpkin, gourd, yam, barley,

sugarcane, wheat, maize, walnut, peanut, gram, soya bean, lucern, alfalfa, pea, tamarind, broad bean, onion, leek, asparagus, yucca, hemp, banana, guava, pepper, almond, cherry, peach, apple, pear, rose, coffee, jasmine, lemon, weeping-willow, red pepper, tobacco, petunia, egg-plant, potato, cocoa, jute, coriander, carrot, grape, turmeric and ginger. The worm forms galls deep in the cortex of the root. Heavily infected plants may be killed outright. In moderately infected cases, the plants are stunted in growth and they readily wilt in dry weather. The leaves die at the edges and there is a protracted death.

10. *Aphelenchoides fragariæ* (Ritzema Bos, 1891).—This affects the strawberry plant and is both ecto- and endo-parasitic. The affected plants are deformed, their leaves become dwarf and the blossoms are also greatly affected. The entire plant becomes red.

11. *A. cocophilus* (Cobb, 1919).—This affects the root and stem of the coconut palm. In affected plants, the leaves become yellowish or brown, nuts are shed in raw condition and there is a shedding of leaves.

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SILVER JUBILEE CELEBRATIONS OF THE PATNA UNIVERSITY

UNDER the inspiring guidance of its Vice-Chancellor, Lt.-Col. Dr. Sachchidanand Sinha, the University of Patna celebrated its Silver Jubilee in the last week of November. During his tenure of office, the University has made remarkable progress; the number of students in the University has been nearly trebled, new colleges, both in arts and science, have been established, and research and higher study has been stimulated by the establishment of a number of fellowships and research scholarships. It was, therefore, in the fitness of things that the Patna University celebrated its Silver Jubilee during the Vice-Chancellorship of Dr. Sinha.

The celebrations commenced with inter-collegiate games and sports. A special Convocation, presided over by H. E. Sir Thomas George Rutherford, the Chancellor, was held on the 30th November, where degrees, *honoris causa*, were conferred on seventeen members distinguished in the realm of law, art, literature and science. The recipients of the degree of Doctor of Law were the Right-Honourable Sir Tej Bahadur Sapru, Sir Maurice Gwyer and Khwaja Sir Mohammad Noor. The degree of Doctor of Science was conferred on Sir M. Visvesvaraya, Sir C. V. Raman, Sir Ziauddin Ahmed, Dr. Birbal Sahni, Dr. A. L. Mudaliar, Dr. H. J. Bhabha, Dr. P. K. Parija, and on Sir S. S. Bhatnagar *in absentia*. The degree of Doctor of Literature was conferred on Sir S. Radhakrishnan, Sir John Sargent, Sir Jadunath Sarkar, Dr. D. N. Sen, Dr. Amarnath Jha and Dr. John Matthai. In addition to these distinguished guests, Patna had the rare privilege of welcoming at their special Convocation the Vice-Chancellors of the Universities of Rangoon and Colombo. The special Convocation was addressed by Sir S. Radhakrishnan. All the members of the Inter-University Board also attended this Convocation.

The Inter-University debates in English, Hindi, and Urdu marked an interesting feature. Sir C. V. Raman acted as one of the judges and gave away the prize for the English Debate, which consisted of a beautiful casket in silver containing 25 pillars to mark the Silver Jubilee and having at the top a relief map of Bihar and a miniature of Asoka's pillar and pictures in relief of the temple at Bodh Gaya, the tomb of Sher Shah, the Golghar at Patna, the Wheeler Senate House, and Buddha in a sitting posture. The Trophy was won by the University of Madras. The Trophy for the Hindi Debate was a beautiful miniature of the temple at Bodh Gaya and was won by the Gurukul, Kangri. Both the Trophies are named after the present Vice-Chancellor as the "Sachchidanand Sinha Trophy". Lucknow University won the Ibrahim Hosain Trophy for Urdu Debate.

On the occasion of the special Convocation, H. E. the Chancellor announced the receipt of several generous donations and endowments, notable amongst which were a donation of Rs. 1,00,000 by the Maharajadhiraj of Darbhanga, of Rs. 35,000 by Mr. G. D. Birla, of Rs. 25,000 by Mr. P. C. Tallents, I.C.S. (Retd.), and of Rs. 25,000 by Mr. Gurusaran Lal. In addition to these, Messrs. Tata and Co., Ltd. have donated a sum of Rs. 60,000 towards a chair in Geology, to be called the "Jamshedji Tata Chair". The Government of Bihar have instituted a foreign scholarship to be awarded alternatively in applied chemistry and electrical engineering. Numerous other donations have been received, the total sum up to the present being Rs. 3,11,170.

The celebrations were enlivened by a banquet in honour of the guests, a musical demonstration by the artists of All-India fame, and by a number of lectures and addresses by distinguished speakers.

P. B. GANGULY.

CLASSIFICATION OF PRE-HISTORIC SITES IN INDIA*

By Dr. S. PARAMASIVAN

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INVESTIGATIONS into Indian prehistory[1] have been comparatively rare, as the subject generally lies outside the scope of an ordinary archæologist, anthropologist or geologist. In addition to training in archæology and its methods, prehistory requires a basic knowledge of geology,[2] ethnology, comparative anatomy, palæontology, zoology, botany, chemistry and the like. It is, therefore, a happy augury that an exploratory branch of the Archæological Survey of India has been constituted with a geologist in it for conducting preliminary survey of prehistoric sites in India.

Bruce Foote,[3] de Terra[4] and others have shown that India is rich in the remains of the earliest phases of the stone age culture. These remains occur in the Kashmir valley, in the alluvia of the upper Indus and in the river basins of the Narbada, the Sabarmati, the Godavery and the Krishna, the Sabarmati, the dant in South India. In addition, there are upper palæolithic, Azilio-Tardenoisean and Capsian industries at Chakradharpur, geometrical microliths of the Tardenoisean variety at Jubbulpur and Magdalenian industry of blades and bone implements with a fauna, some of which have become extinct, in the Billa Surgam caves in Kurnool district.[5] The Campignian stage of culture comes from Banda and Murpha, mid-neolithic phase from Bellary, which merges into the iron age, and shouldered celts and implements and weapons of copper, bronze and iron from Chota Nagpur and Assam.[6] There are also countless megaliths which range from the neolithic to the historical times.

What is the sequence of these cultures? What relation do they bear to similar cultures elsewhere? What part did they play in cultural diffusion? Does the presence of iron in the neolithic sites in Bellary signify that India originated this industry? Or is it a case of zones persisting late in the stone age and passing suddenly into that of iron? Who were the peoples responsible for the megaliths in India and what part did they play? These are some of the problems that face the prehistorian and they are difficult of solution for the present. The difficulty is intensified by the surprising juxtaposition of peoples living in various stages of culture. But in the ultimate analysis, all these problems resolve themselves into questions bearing on classification of prehistoric sites. In fact, classification is the basis of prehistoric work proper.

Scientific classification is based necessarily on scientific excavations. Barring a few notable exceptions, scientific excavations have not been systematically practised in India. As instances of crude excavations by the method of the plough—to quote an eminent archæologist—may be mentioned those at Perumbair in the Chingleput district, Adichanallur in Tinnevelly district and elsewhere. The antiquities unearthed by such methods and exhibited in museum galleries have little or no archæological value, unless correlated with similar finds excavated at the same sites by modern scientific methods. The immediate task is to plan out and conduct excavations scientifically before attempting at final classification of the sites.

Nearly thirty years ago, Bruce Foote published a monumental work on the "Indian Prehistoric and Protohistoric Antiquities", which is considered a *magnum opus* of the Madras Government Museum in prehistory. In the distribution map which is annexed to this volume, the prehistoric sites in India are found concentrated round Madras, in the valley of the river Krishna, in the region enclosed by Raichur, Kurnul, Guntakal and Gadag. There are other concentrations in Gujarat, in Baroda and in the valley of the Sabarmati river. On looking at this map, one feels interested in the conditions that determined such distribution and to know whether they operated simultaneously or in some sequence. But no satisfactory answer is possible at present. In order to study the distribution scientifically, one must have before him a list of all the available prehistoric sites. The sites must be projected on a topographical map. Such a map will then reveal the different combinations of physical and climatic conditions that determined the distribution. It will also reveal some aspects of the personality of prehistoric India. The distribution map will probably enable one to divide the sites into groups and to differentiate the conditions that separate one group from another. Typical sites are taken from each group, scientifically surveyed and excavated. A close study of the prehistoric finds with the characteristic strata associated with them brings out clearly the stages of development of prehistoric civilisations and their contribution to and relation with other known sites. Thus a preliminary listing of prehistoric sites is very important for preparing the topographical distribution map on which alone systematic excavation can be conducted.

There are several lists of sites giving us valuable information: Sewell's List of Antiquities; Coggin Brown's Catalogue of Prehistoric Antiquities in the Indian Museum; Various Government Orders bearing on Prehistoric Sites; List for Coorg; Bruce Foote's Catalogues published by the Madras Government Press; Annual Reports of the Archæological Survey of India; Das Gupta's Bibliography of Indian Antiquities; Information regarding prehistoric sites supplied to museums by various authorities; List for Ramnad district prepared by a Zamin Tahsildar; List of Pudukkotai State; District Gazetteers and personal observations of that brilliant enthusiast, L. A. Cammiade, now in the possession of V. D. Krishnaswami. Some of these lists are not available to the public. They have been consolidated into a

* Paper read before the Archæological Society of South India.

comprehensive list by Krishnaswami and it is now with the Archæological Survey of India. But the lists require verification and checking through preliminary surveys. In this preliminary survey, emphasis must be laid on surface indications, the nature of potsherds, the nature of chipped and polished implement, topographical and geological features associated with the finds, the nature of the megaliths and so on.[7] It is needless to emphasise the importance of such surveys for the whole of India including Indian States, preferably under a single authority or in close co-operation with experts engaged in similar work.

For a fuller understanding of the personality of prehistoric India, the distribution maps must be prepared on the results of detailed excavations and classification of excavated sites. There are different aids to this classification and they can be grouped as follows:—

1. *Fossil Study.*—The prehistoric sites are studied in relation to fossil indices associated with them. Organisms are found to undergo progressive changes from one set of geological strata to another. In other words, geological strata can be identified and their sequence established by the fossils enclosed therein. Thus the prehistoric artefacts associated with them are dated. This classification is applied to early palæolithic sites in the Kashmir valley and in the valley of the upper Indus, the Narbada, the Sabarmati and the Godaveri. Fossil finds have not so far been discovered in the lateritic sites of South India.

The earliest cultural strata in India are those of the II Glacial period, which are associated with the earliest flake industry. In this are usually found *Equus, Bubalus, Hippopotamus* and *Elephas namadicus.* But in the Kashmir valley, only a few rolled bones of birds and bovids and *proboscidens* are found.[8] This lack of fossil record is due to the extinction and migration of the fauna on the approach of intense cold due to the II glaciation. Other glacial and interglacial epochs are almost entirely free from fossil remains.

In the lower group of the Narbada valley, *Elephas, Hexaprotodon namadicus* and *Bos* are associated with Abbevillian and Acheulian tools. In the upper group, early palæolithic rolled flakes and cores and late Soan tools are found in association with *Elephas namadicus, Equus namadicus, Hexaprotodon, Bos, Bubalus, Sus, Trionyx*, etc. Stone implements have been found with *Elephas namadicus* and *Bos* in the Godaveri valley. The sites round about Madras are devoid of fossils.

Pleistocene land and fresh water and marine mollusca must be studied as indicators of time, climate and ecological conditions.

2. *River Terraces.*—The prehistoric sites are classified in relation to river terraces, whch are definite geological formations occurring in some sequence. Researches conducted by de Terra, Patterson and Teilhard de Chardin have shown that there is a palæolithic stratification in the alluvia of the upper Indus Valley, which blend with the Himalayan moraines. Thus the glaciated tract coalesces with the non-glaciated region of the plains. The latter contains fossiliferous, and hence dateable, upper Siwalik beds. This classification is useful where the sequence of terrace formations containing artefacts have been worked out with fossil indices or in relation to terminal moraines. For example, in the Siwalik foothills and in the plains of the N.W. Punjab, Poonch and Jammu, there are four terraces, T_1, T_2, T_3 and T_4.[9] Of these T_1 was formed during the II interglacial stage and is associated with Chello-Abbevillian and early Soan cultures. T_2 consists of Potwar loessic silts and the Soan industry of the III glacial period. The third terrace T_3 was formed during the III interglacial stage and is associated with the Soan industry.

On the other hand, the terrace in the Narbada are not so clearly marked and the study of their stratigraphy is possible only through correlation with fossil indices of the northwest Punjab.[10] There are five terraces, namely, T_1, T_2, T_3, T_4 and T_5; T_1-T_2 go with early Soan and T_3-T_4 with late Soan. On the other hand, the terraces of the Courtallaiyar river in the south are clearly marked, but are devoid of fossil horizons. Hence we have to use typical implements as indices to fix the stratigraphy and sequence of the terraces formed during the pluvial and interpluvial periods. These contain implements of the Abbevillian-Acheulian type in the first terrace, Acheulian in the second terrace, late Acheulian and Levalloisian in the third terrace and the Upper Palæolithic in the fourth terrace.[11]

3. *Geochronology*[12].—It is possible to date and classify prehistoric sites by correlating them with geochronology. On the conclusion of the glacial epoch and at the beginning of the mesolithic period, the ice melted and fine mud sediments were deposited in the melt waters. The coarse particles settled down in summer and finer particles in winter. As years rolled on, alternate layers of coarse and fine sediments formed distinct seasonal laminations or varves, all the varves resting one above the other, though not in direct vertical succession. A number of sections at intervals apart are correlated and the complete sequence of sediments, in relation to human artefacts contained therein, established. Baron de Geer has worked out the geochronology of Sweden for 12,000 years. This method is applicable to the Himalayan regions which were subjected to glaciation. It remains to be examined whether the end of the pluvial period has left similar stratigraphy, though the problem of identification may be more complex.

4. *Profiles of Weathering*[13].—The upper portion of a natural, undisturbed deposit in a vertical or nearly vertical section is subjected to weathering. This is brought about by processes which operate through sufficiently long geological time. These processes, which are of a physical or chemical nature, leave their impress. In other words, the profile reflects the climatic, topographical and vegetative environment in which the deposit has existed.

There are several stages of profile development, namely, stages of infancy, youth, maturity and old age. A profile of weathering is in its stage of infancy when it shows only the beginning of the subdivisions of the weathered zone. There are four clearly marked subdivi-

sions from the top down distinguishing the stage of youth, thus:—

(*a*) An eluviated top soil in which most of the coarse-grained arkosic rocks and limestones have been weathered out.

(*b*) An illuviated subzone which is brownish in colour and is compact and plastic and into which clay particles from the top layer have been introduced. From this, limestone pebbles have been dissolved, but the arkosic rocks are still present.

(*c*) Below (*b*) is a yellowish, oxidised zone. It is less compact than (*b*) and is unleached of its calcarious materials.

(*d*) The previous one grading down to unaltered parent material.

A profile of weathering is said to be in a stage of maturity when it is characterised by the following four subdivisions thus:—

(*a*) A top soil resembling the one in the previous case. It may be more siliceous in chemical composition and less fertile.

(*b*) A "gumbo" (very plastic, but compact when wet and hard and jointed when dry) in cases where the topography is flat and poorly drained. If the topography is rolling and well drained, it may contain a silty material with all gradations between for intermediate types of topography. Pebbles are few, small and most resistant. Granites and other arkosic rocks are rare. Limestone is absent and there is some concentration of ferric oxide at the base.

(*c*) Material is leached of the calcareous matter and is oxidised to rusty colour. Otherwise it is but little altered.

(*d*) Material is oxidised to yellowish colour. but unleached of its calcium carbonate.

(*e*) At the bottom there is the unaltered material.

Probably the laterite deposits, as in S. India, represent the profiles of weathering referred to the old age stage.

In the more humid region, the stages of profile development range from infancy to maturity. The silts on the second flats of streams show a profile of weathering characteristic of the stage of infancy. There is a fairly uniform charge of humus matter and there is little or no leaching. The higher levels of streams show a profile of weathering in the stage of early youth. The soil layer is charged with humus matter. It is a compact zone with columnar structure ranging in thickness from 12 to 18 inches. The mature profiles of weathering show a well-developed layer at the top, "gumbo" in the lower, second horizon, with a rusty zone at the base, and caliche and much less weathered, stony silts in the third lower horizon. Petrographic examination shows that the soil has been subjected to prolonged weathering. It is composed of grains of quartz which are rounded and 1 mm. or less in diameter, cemented together with iron hydroxide, amorphous silica grains, large grains of quartz, and a few pellets of iron, alumina and manganese. Similar interesting details are revealed in other layers.

Thus minute and detailed attention should be devoted to profiles of weathering. This aids in the correlation of physiographic levels and in the understanding of the stratigraphy of surficial deposits. It is clear that more work on geology of the surficial deposits along with physiographic levels and profiles of weathering, from one region and climate to another, is of importance. The different physiographic levels can be correlated with the cultural horizons occurring in them.

With reference to the methods enunciated above, much useful information can be gained through co-operation with the Geological Survey of India, who have intimate knowledge of the topography of the country, of the rocks and their weathering characteristics.

5. *Vegetation*: (*A*) *Pollen Analysis*[15].—During the post-glacial and post-pluvial times, the development of forests passed through a series of phases. These afford a chronological sequence of great value to geology and archæology. In the glaciated tracts of Europe and America, pollen analyses have been conducted with a view to dating cultural materials. Through this method there is the elucidation of past climates and vegetation as recorded by the stratification of wind-borne spores, preserved in organic, terrestrial sediments. The organic remains themselves may give a picture of the change, but it is of a local nature. On the other hand, a more general record is presented by the pollen grains which are blown from the neighbouring forests and other plant communities. Such micro-fossils are well preserved in peat and similar deposits in cool, humid and glaciated regions. Recently, the principle has been extended to made-up mounds and the associated artificial lake as at Ft Smith, Arkansas in U.S.A. In this country, however, pollen analysis in relation to archæological finds are not even in the exploratory stage.

In this method one must secure typical pollen profiles for a particular region. Any single profile records the varying percentages of pollens found at successive depths and is characteristic of the region concerned. Once these standard regional profiles are available they have several applications. Archæological materials found in different places in the same deposit of peaty material or in different deposits of the same region can be correlated. The pollen analysis reveals the climate and other environmental conditions, which assist in the reconstruction of the cultural conditions associated with artefacts.

In Europe a precise chronology through correlation of varve counts and pollen profiles has been established. It is therefore suggested that to serve the interests of archæology, the following studies must be undertaken in India:—

(*a*) A methodical exploration of suitable peat deposits for cultural remains.

(*b*) A systematic prosecution of pollen studies throughout the country until standard profiles of reference are obtained for each region and the sequence of post-glacial and post-pluvial events is determined.

(c) Correlation of the above events with erosion and sedimentation, both within and without the glacial areas.

Peat deposits occur in the Nilgiris, Travancore, Bengal and Assam.

(B) *Charcoal*[16].—When widely separated sites are compared, there are many sources of error in the results of pollen analysis. Hence, in pollen analysis the geographical position of each site and the peculiarities of its local conditions must be taken into account. In this respect, charcoal found in the sites yields better results. Through identification of sufficient samples of charcoal, the contemporary forest composition is reconstructed in much the same way as through pollen analysis. But the charcoal must be typically representative and must reflect the natural conditions and not be result of selection of man. Such conditions are available in rock shelters and caves as in *Billa Surgam*. Charcoal analysis forms a confirmation of the results of pollen analysis.

The identification of the charcoal is effected by studying the pores, medullary rays, wood fibres, storage parenchyma and the resin ducts in specially prepared specimens.

(C) *Peat Accumulations*[17].—The correlations of varve counts and pollen profiles, and through it, a precise chronology, has been established in Europe. By studying the rate of peat accumulations a rough approximation towards chronology has been developed. This has been made possible by attention to lamination found in peat and also by the study of the depth of objects of known age. The rate is not always continuous, but varies with climate. But oxidised layers cannot be considered. For example, in the Erie basin in the U.S.A., 25 years to the inch in peat older than 30 years has been obtained while in Wyoming mountains, it is 10 years to the inch.

(D) *Humus*[18].—Sears and Couch[18] have worked out humus stratigraphy as a clue to past vegetation of Oklahoma. This has a good future in India for working out archæological strata.

6. *Phosphate Analysis*[19].—Prehistoric sites can be classified in relation to the density of population of the dwelling place sites associated with them. The method depends on the fact that, where the human settlement has been intense, the phosphate content of the soil tends to be higher than in areas which are not habitation sites. The presence of phosphate is due to the presence of bones which have become discarded and decayed. The soil of an area of intensive settlement contains almost fifty times as much phosphate as ordinary soil does. In conducting this investigation, a series of soil samples are taken at equal intervals along a series of straight lines radiating from some central point, preferably the supposed centre of settlement as indicated by antiquities or other features. With these values are constructed contour maps illustrating varying phosphate content and these phosphate contours are then correlated with height contours. Similar diagrams are constructed for the frequency of potsherds. One acts as a check on the other for one and the same place.

7. *Typology*.—The types of implements associated with prehistoric sites serve as a method of classification. For example, eolithic, Chellean, Abbevillian, Acheulian, Micoquian finds are characteristic of the lower palæolithic period. In the middle and upper palæolithic periods, there are the Mousterian, Aurignacian, Solutrean and Magdalenian industries. For the Mesolithic period, there are the Azilian, Tardenoisian and Asturian industries. Sites having the Eolithic, Abbevillio-Acheulian and Soan industries have been found in N. India and in the Narbada valley. In the south, there are the Abbevillian, Acheulian and Micoquian industries. In applying this classification, there is apt to be some confusion between the technological stages and geological sequence as pointed out by Glyn E. Daniel.[20]

Regarding surface finds, it is unlikely that all of them belong to the same period. In such cases one must work out the frequency of the types and classify the site with reference to the largest number of the particular type or types occurring. In fact, Indian types have not been systematically worked out for the whole country.

8. *Pottery*.—Sites can be classified in relation to the information conveyed by prehistoric pottery. The neolithic and megalithic sites yield pottery. And pottery is one of the expressions of art, whether it be most graceful or most clumsy. It expresses the artistic sense of the prehistoric race, their mechanical perception, their sense of utility, adaptability and response to other civilisations. It serves as an index to the growth and development of their civilisation. The pottery can be used in sequence dating as in Egypt and Palestine.[21] Prof. T. Balakrishna Nair has done some pioneering work in this field.

Taking pieces of pottery from suitable sites, those which are decadent in style are classed sparately as late pottery. Others are divided into different classes of dork, with such modifications as are necessary, thus: (1) Black-topped pottery baked partly in ashes, (2) polished pottery, similar but baked in flame, (3) the fancy forms—square, oval, double boats, etc., (4) red pottery with white line designs, (5) black pottery with incised designs, (6) wavy-handled pottery with two ledge handles, (7) decorated pottery with red painted designs. The forms are chiefly classed from the most open such as shallow saucers to the most closed such as bottles. The bowls are classed by the slope of the edge with due regard to the different degrees of incurving. Another criterian is the proportion of the height to the width. A number of sites is examined and the proportion of the different forms is worked out. These proportions reveal the sequence in the development of pottery and hence the basis of sequence dating. If an unknown site is to be defined, its pottery is studied and its position fixed in the series. These aids to classification do not, of course, bar others based on associated finds, their technique, if any, and geological law of superposition.

Thus vlauable field evidences will be destroyed through unscientific excavations. Even salvaging of prehistoric antiquities must be done under control.

In this short resume, the study of prehistory is considered from a range of viewpoints which enable one to get a clear picture of the conditions obtaining on earth in those early stages

of human history. It is difficult for any history to write its own beginnings. But prehistory is an exception. The fossils, the river terraces, geochronology, pollen grains and potsherds have left their indelible records. An understanding of the major problems from the point of view of geology, geography, climatology, palæontology, biology, anthropology, archæology enables one to develop a perspective of value in one's efforts to understand early human history. Thus in classifying the prehistoric sites, each of the methods enumerated above has its own merits and limitations. As many of the aids enumerated here as possible must be applied to a given site and the cumulative evidence critically evaluated. But the methods are complex. Even the geological ones have not been properly worked out in India. There is an urgent need to build up the necessary technique in collaboration with experts working in various branches, in order to be able to reconstruct India's prehistory which, there is reason to believe, will yield a rich harvest of knowledge. At the present time the Archæological Survey of India, under expert guidance of Dr. Mortimer Wheeler, is best fitted for this task.

1. The terms "Prehistory" and "Protohistory" have been used somewhat differently by M. C. Burkitt (*vide* p. 1. *The Old Stone Age* Cambridge University Press, 1933), and by Sir Leonard Woolley (*vide* para 19, *A Report on the Work of the Archaeological Survey of India*, 1939). This must be clarified for India by an agreed terminology. 2. Sir Leonard Woolley, *Loc. cit.*, para 19. 3. *The Foote Collection of Indian Prehistoric and Protohistoric Antiquities*, Madras Government Press, 1916. 4. *Studies on the Ice Age in India and Associated Human Cultures*, Carnegie Institution of Washington, Publication No. 493, 1939. 5. Panchanan Mitra *Prehistoric India*, Calcutta University, 1927, pp. 186–87; 190–91. 6. —, *Loc cit.*, p. 231. 7. Bruce Foote, *Catalogue of Prehistoric Antiquities*, Madras Government Press, 1901, p. vi; Sir Leonard Woolley, *Loc. cit.*, para 19. 8. de Terra and Patterson, *Loc. cit.*, p. 226 9. —, *Loc. cit.*, pp. 223–31. 10. —, —, *Loc. cit.*, pp. 313–21. 11. Krishnan, M. S., *Geology of India and Burma*, Madras Law Journal Office, 1943, p. 489. 12. De Geer, Gerard, "Gotiglacial Broadmapping, Sweden—New York Manuto a", *Report of the 16th Intern. Geol. Congr., Washington, 1899, Washington*, 1936, 1, 192–202. 13. Leighton, M. M., "The significance of profiles of weathering in stratigraphic archæology", *Early Man*. 15. Clark, J. G. D., *The Mesolithic Settlement of Northern Europe*, Cambridge University Press, 1936, pp. 31–44. 16. Cecil Mary, J., "The Identification of Wood and Wood Charcoal Fragments," *Analyst*, 1932, 57, 2–8. 17. Wright, W. B., *The Quaternary, Ice Age*, Macmillan & Co., London, 1937, pp. 450–51. 18. Sears, Paul B., and Glenn, C. Couch, "Humus stratigraphy as a clue to past vegetation in Oklahoma," *Proc. Okla Acad. Sci.*, 1935, 15. 19. Schnell, I, *Strandlinjebestamningar och Markanalys, Fornvannen*, 1932, pp. 40–47. 20. *The Three Ages*, Camb. Univ. Press, 1943.

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DEPARTMENT OF CHEMICAL TECHNOLOGY, UNIVERSITY OF BOMBAY

The Annual Report for 1943–44 of the Department of Chemical Technology of the University of Bombay, gives a very pleasing account of the increasingly rapid growth in its activities, aided by a continuous inflow of generous endowments made for furthering the valuable work carried out by the Department. These endowments have been duly announced in our columns from time to time. As a result the Department is or will soon be able to offer degree courses in Oils, Fats and Soaps, and Plastics, Paints and Varnishes (Sir Homi Mehta endowment of Rs. 7 lakhs), a Pharmacy Laboratory with excellent facilities for advanced teaching and research in pharmaceutical chemistry (Topiwala endowment of Rs. 1·25 lakhs), a fully equipped section in Dyestuff Technoloby and Laboratories for advanced research in textile chemistry and modern methods of textile finishing (Bombay Millowners' Association—Rs. 3·92 lakhs).

While it is but natural that admission to this Department for the various courses should be primarily available for the graduates of the Bombay University, it is to be regretted that the admissions are restricted exclusively to them (except for 40 per cent. of the seats in the Intermediates and Dyes Section, financed by the All-India Board of Scientific and Industrial Research). For one has only to just contemplate over the effects of a similar dictum regarding admissions to the Massachusettes Institute of Technology, or the technical departments of the Sheffield University, etc.

The section of the *Report* dealing with research papers published and works in progress indicates that as usual a volume of valuable researches are beieng carried on by the staff and post-graduate students. In addition, the following schemes are in operation under the auspices of the Board of Scientific and Industrial Research: (i) Preparation of Vat Dyes, (ii) Determination of the Constitution of some Commercial Dyes, (iii) Synthetic Dyes and Modified Shades from Cutch, (iv) Preparation of Aniline from Chlorobenzene.

It is interesting to note that the section for analysis and technical investigations handled last year 209 enquiries involving 451 analytical estimations, and a number of investigations of the type, 'Porosity and thickness of electro-tin plates with a view to ascertain their suitability for storing hydrogenated oils', 'analysis and examination of used photographic solutions for recovery of chemicals', etc. It is rather intriguing to read that "the work of the Section has indicated a general tendency towards unskilled adulteration. Thus starches have been very commonly mixed with tamarind flour, udud dal and even clay. Gums have been found mixed with china-clay or starches; sulphur blacks have been liberally mixed with coal-dust; a sample of sodium sulphate was passed off as barium chloride; castor-oil soaps are being sold as vegetable tallow; and numerous cases of a similar character are being repeatedly detected and reported upon".

LETTERS TO THE EDITOR

INFLUENCE OF SODIUM BISULPHITE ON ADRENALINE

In view of the recent publication of Richards[1] on the influence of sodium bisulphite on the toxicity of adrenaline, we wish at this time to record our experience in this field.

Sjögren and Larsson[2] first noticed that sodium metabisulphite stabilised adrenaline solution. In the 4th *Addendum* to B.P. (1932) incorporation of the above salt to an injection of procaine and adrenaline has also been advocated (*cf.* Woolfe[3]). It is being noticed by us that this salt protects the above solution and even liquor adrenaline hydrochloride from a sort of oxidation that is partly responsible for the development of a pink colour in the solution. But the bisulphite salt of alkali metal invariably increases the toxicity of the solution.[4]

The direct influence of sodium bisulphite on adrenaline was shown by dissolving pure adrenaline base (0·1 gm.) in water (100 c.c.) containing molar amount of sodium bisulphite, and the pH was adjusted to ca 6·5 with sulphur dioxide in one case and to 2·8 in another. The solutions were heated at 80° C. for 100 hours in an atmosphere of carbon dioxide. No change in colour was noticed in any solution but the potency on biological assay on decapitated cat was found to be practically nil in the former and only 45 per cent. in the latter. 'Control experiments were also done by preparing solutions of pure l-adrenaline base (0·1 gm.) in water (100 c.c.) saturated with carbon dioxide without any addition of sodium metabisulphite and sulphur dioxide. The pH of one solution was adjusted at 6·5 by passing more of CO_2 gas in the cold and at 2·8 in another with a trace of hydrochloric acid gas. On heating the solutions at 80° C. for 100 hours in an atmosphere of carbon dioxide both the solutions became somewhat coloured but the potency on biological assay was found to be 42·2 per cent. in the case of the former and 65·5 per cent. in the case of the latter.'[4] These show that the bisulphite has a direct destructive action on the physiological activity of adrenaline. As such it is a question whether any parenteral solution containing adrenaline should be mixed up with any alkali metal salt of sulphurous acid. Details of the work are being published elsewhere.

Bengal Immunity Research Laboratory, Calcutta, S. K. Ganguli.
August 7, 1944.

1. *J. Pharmacol.*, 1943, **79**, 111. 2. *Farm. Revy*, 1936, **35**, 309. 3. *Quart. J. Pharm. Pharmacol.*, 1941, **14**, 234. 4. Bose, A. N., *Private communication.*

COMPOUND—BI-COMPOUND LEAF TRANSITION IN *PELTOPHORUM FERRUGINEUM* BENTH.

Peltophorum ferrugineum Benth. is a common ornamental avenue tree said to be indigenous to Ceylon and Malaya (Macmillan[1]). Its leaves are generally bicompound, the number of secondary rachises varying from four to six; the number of pinnæ per secondary rachis is about ten to twelve pairs. It was observed almost as a feature of common occurrence that on the adult tree there were a few leaves which were pinnately compound instead of bipinnately compound. The number of leaflets was approximately equal to the number of secondary rachises in the bipinnate leaves. A number

of seedlings were raised for critical observation and they exhibited almost all the stages of transformation from a single leaflet into a collection of pinnæ. Figure shows a seedling in which all the stages are represented. In leaf 1, there are 6 pairs of leaflets pinnately arranged. Leaf 2 is a normal bicompound leaf with five secondary rachises. In leaf 1, we see all the stages of the division of the leaflet into smaller segments—the pinnæ. In other words, we could see the derivation of the bicompound leaf from a pinnately compound leaf. It is generally admitted that phylogenetically the compound leaf is derived by the segmentation of a simple leaf-lamina and the subdivision of the leaflets leads to the formation of the pinnæ of the bicompound type. Troll[2] has discussed the possibility of such a derivation. His figures show clearly all the stages that have been noticed in *Peltophorum ferrugineum*.

It is interesting that in the juvenile condition there is almost a recapitulation of the phylogeny of the bipinnate leaf. Just as in the case of some Australian Acacias there is a recapitulation of all the stages leading to the ultimate formation of the phyllode, even so in *Peltophorum* we find all the stages leading to the formation of bipinnate leaves recalled in the juvenile condition. A number of seedlings were examined and almost without exception this transition from pinnate to bipinnate condition was seen. This tendency to subdivision was also found to be extended to the pinnæ themselves, though rarely. In leaf 3, we find one of the pinnæ already subdivided into smaller segments. No case of complete segmentation of all the pinnæ leading to the tripinnate condition was, however, met with. But a tendency towards that is unmistakably exhibited.

The seedlings of *Peltophorum ferrugineum* can well be employed for purposes of visual demonstration of the evolution of the bipinnate condition from a pinnate leaf.

I wish to express my indebtedness to Prof. T. S. Raghavan for having drawn my attention to this and for suggesting relevant literature.

Department of Botany,
Annamalai University,
Annamalainagar, K. V. KRISHNAMURTHY.
August 17, 1944.

1. Macmillan, H. F., *Tropical Planting and Gardening*, 1935. 2. Troll, Wilhelm, "Vergleichende Morphologie der höheren Pflanzen" *Erster Band: Vegetationsorgane*, 1939, page 1463, *Abb.* 1212.

POTATO 'TOPS' AND 'EYES' AS SEED

THE potato is an important food crop. Also it can provide raw material for the manufacture of starch, alcohol and synthetic rubber. During this war, therefore, attempts have been made to increase its area, especially in the U.S.S.R. As the seed supply was found to be the limiting factor in the expansion of the area under potato cultivation, Professor Lysenko and his co-workers[1] proposed to utilize as seed a small piece from the rose end of the tuber containing one or more eyes and to use the rest of the tuber (representing about 90 per cent. of the whole) for food. It is reported that the 'tops' yielded as well as the whole tubers and that their produce was less subject to disease. The idea was carried still further by Professor Yakushkin (quoted by Garner[2]) who devised a method of 'tuberless' sowing of potatoes. The seed in this case is the eye itself with a small piece of flesh attached. Copisarow[3] reported certain experiments on 'tops' and peelings which seem to have given satisfactory results. Evans[4] studied this problem from the point of view of the possibility of transporting by air potato 'tops' for seed purposes to certain British overseas dependencies. His preliminary experiments indicate that 'tops' give a satisfactory yield. It would, thus, appear that small piece of the tuber might suitably be substituted for the whole tuber as a wartime measure. An experiment was, therefore, conducted during 1943-44 at the Imperial Agricultural Research Institute, New Delhi, with a view to finding out the possibility of utilizing potato 'tops' and peelings as seed under the conditions of the plains of North India. The results are reported herein.

Whole tubers, halves and 'tops' of *Phulwa* and *Gola* varieties which are generally cultivated in the plains of North India, were planted directly in the field on November 5, 1943. Farmyard manure at the rate of eight cartloads per acre was added to the plot just before planting. The tubers or tuber pieces were planted in rows 2 feet apart and were spaced at a distance of 1 foot in the row. The average weight of the *Phulwa* tuber used in this experiment was 21·45 gms., that of the

half tuber was 10·72 gms., while the 'top' weighed 4·2 gms. The weights of *Gola* were 33·57 gms., 16·78 gms., and 6·4 gms., respectively. Thus the 'tops' were one-fifth size of the whole tuber. If bigger tubers are used, the size of the 'tops' would remain the same as the one used in this experiment. The 'tops' germinated along with the whole tubers and the halves and in the early growth period the young plants of all the three lots were equally vigorous. During the growing period observations on height and number of leaves were taken. The plants were harvested on March 23, 1944, and their yields were recorded. These observations are summarised in Table I.

Tubers harvested from plants from whole tubers, halves and 'tops' were of the same size in the case of *Phulwa*. In *Gola*, on the other hand, tubers from 'tops' were slightly smaller than those from whole and half tubers.

From Table I it would appear that (i) percentage of germination of 'tops' was as high as that of whole and half tubers; (ii) plants from 'tops' did not have the same luxurious vegetative growth as the plants from whole and half tubers; (iii) the 'tops' yielded less than whole and half tubers. *Phulwa* seems to be a more suitable variety than *Gola* for planting 'tops' as seed.

Peelings or skins of *Phulwa* and *Gola* each containing an eye, were first planted 6 inches apart in boxes on November 2, 1943. Seedlings were then planted in the field on December 22, 1943. They had a spacing of 1½ feet between them and 2½ feet between rows. Farmyard manure was added to the boxes and to the field before planting. Few plants did not survive after transplanting and few others were damaged by porcupines. Observations on germination, growth and yield were taken and are summarised in Table II. Although whole tubers were not planted in the boxes along with the 'eyes', the yield of plants from whole tubers planted in the field nearly at the same time were recorded for comparison.

The size of the tubers harvested from plants raised from 'eyes' both in *Phulwa* and *Gola* was small. It will be clear from Table II that 'eyes' gave rise to plants poor in growth and also poor in yield.

Although poor yields were obtained from plants raised from 'eyes', the yields of those from 'tops', at least in the case of the *Phulwa* variety, were not very unsatisfactory as compared with those of plants from normal seed. It might be possible to compensate for the decreased yield per plant by adopting a closer spacing, and by suitable manuring, and experi-

TABLE I

Observations on germination, growth and yield of plants from whole tubers, halves and 'tops' of Phulwa *and* Gola

Variety	Kind of seed used	No. of sets planted on 5-11-43	No. of plants germinated	Average height in cms. on 17-12-43	Average height in cms. on 19-2-44	Average No. leaves per plant on 17-12-43	No. of plants harvested on 23-3-44	Actual yield		Yield per 100 plants	
								lbs.	oz.	lbs.	oz.
Phulwa	Whole	108	107	11·1	18·0	31·9	100	51	8	51	8
	Half	108	106	11·7	17·2	33·4	94	42	8	45	3
	'Tops'	103	103	7·3	12·3	20·2	93	32	12	33	6
Gola	Whole	108	103	6·2	10·6	18·3	94	26	0	27	11
	Half	108	106	7·0	10·2	21·0	99	27	8	27	12
	'Tops'	108	104	4·2	6·9	8·4	101	10	8	10	6

TABLE II

Observations on germination, growth and yield of plants from potato peelings

Variety	Kind of seed used	No. of peelings sown in boxes	No. of plants germinated	No. of plants transplanted on 22-12-43	Average height in cms. on 21-12-43	Average height in cm. on 22-2-44	Average No. of leaves on 21-12-43	Average No. of leaves on 22-2-44	No. of plants harvested on 28-4-44	Actual yield		Yield per 100 plants	
										lbs.	oz.	lbs.	oz.
Phulwa	'Eyes'	55	29	28	2·5	3·3	6·0	8·7	15	2	13	18	12
	Whole tubers	Planted directly in the field							15	7	11	51	4
Gola	'Eyes'	51	37	35	2·0	2·6	4·4	7·0	9	0	11	7	10
	Whole tubers	Planted directly in the field							9	2	7	27	1

ments have been laid down to investigate these possibilities. Experiments are also in progress to find out whether 'tops' from dormant or non-dormant tubers would be more suitable as seed, and also to determine the relative value of 'tops' cut from the apical end and those taken from the basal end of the tuber. Experiments to determine how long 'tops' and 'eyes' can be kept in a viable condition are also in progress.

Imperial Agricultural Research Institute, New Delhi, *October* 7, 1944. B. P. PAL. M. J. DESHMUKH.

1. Anon, 'Soviet scientific work on potatoes", *Nature*, 1942, **150**, 453–57. 2. Garner, H. V., "Intensified potato culture in the U.S.S.R.", *J. Min. Agric.*, **1943**, **50**, 20–21. 3 Copisarow, M., 'Potatoes and war economy', *Nature*, 1943, **151**, 421–22. 4. Evans, G., "Potato eyes as really transportable 'seed' for the colonies", *Ibid.*, **1943**, **152**, 464–66.

TONIC ELONGATION OF UNSTRIATED MUSCLE

PLAIN muscle is known to contract on the application of stimuli, but an active elongation has not been hitherto described. Plain muscle is elongated by the application of external extending force, but whether it can do so without the application of such a force is a doubtful point.

The following experiments suggest that elongation may be active. If pieces of the muscle of frog stomach cut transversely, be placed in distilled water, after an initial contraction, it entirely loses all tone and becomes flaccid. It does not however die, at least for two hours, as shown by irratability to electric current or potassium when replaced in normal saline. If the muscle is placed free in a trough, to which distilled water is added, it lengthens without the application of an extending force (Table I). The length was measured by means of a divider and sometimes the muscle had to be very lightly pressed to flatten out any curvature. Elongation occurs at a much slower rate in a moribund muscle; it is difficult to be sure whether such muscles are dead or alive. It appears that normal excitability is necessary not only for contraction but also for elongation.

In 60–75 minutes, a good muscle may elongate to its maximum extent, by almost 100 per cent.; a moribund muscle may take hours. It increases in weight by about 60–70 per cent. The increase in length is due either to the general increase in volume or to active elongation. It does not appear to be due to the former cause as (*a*) the lengthening is rather too great if the muscle should swell in all dimensions, (*b*) there is no correlation between the swelling and the elongation, (*c*) *Mytilus* muscle may swell enormously in 0·564 M. sodium cyanide and yet shorten, (*d*) a control striated muscle elongates to a very slight extent, (*e*) in 0·154 M. potassium chloride, the muscle swells but does not elongate.

The elongation appears to be active comparable to contraction, and is probably due to dilution of the ions in the muscle. It appears that tone is due to combination of ions with the muscle proteins. It could not be due to ions in the saline, as placing the muscle in a sucrose solution causes tonic contraction.

If plain muscle is a purely viscous body, then such an elongation is only possible by means of an external extending force. If the process of contraction is due to some colloidal change attended with changes in viscosity then the return to the original length can only occur by external tension, if the muscle is a pure viscous body. If the contraction is due to some electrostatic attraction, such as between parts of a folding myosin molecule, then lengthening can occur if there is an electrostatic repulsion between adjacent folds, and the molecule will unfold like the leaves of an electroscope. A thrusting tension can only be produced, however, if the muscle is prevented from buckling. The use of a tonic elongation would be to hasten relaxation against internal viscous resistance.

TABLE I (*a*)

Increase in length

Time in hours	Solution	Length in m.m. of frog stomach	Length of frog rectus
0	Saline	18·3	22·2
¼	H_2O	25·0	23·0
½	H_2O	28·2	21·8
¾	H_2O	30·9	21·2
1	H_2O	32·6	21·0
1¼	H_2O	33	20·0
1½	H_2O	31	20·0
1¾	H_2O	33	
1¾	KCl	33	
2	KCl	18·6	
2¼	KCl	17·0	
2½	KCl	16·8	
3	KCl	15	
4	KCl	15	
24	KCl	15	
25	H_2O	15	
26	H_2O	16	
27	H_2O	16	
36	H_2O	30	
48	H_2O	30	

TABLE I (*b*)

Increase in weight of frog stomach

Time in hours	In H_2O	In 0·154M KCl
0	0·0 p.c.	0·0 p.c.
1¼	67 ,,	7 ,,
2½	100 ,,	3 ,,
3¼	140 ,,	15 ,,
7¼	180 ,,	20 ,,
24	185 ,,	40 ,,

Department of Physiology, Medical College, Hyderabad, Sind, *October* 17, 1944. INDERJIT SINGH.

THE MAGNETIC STUDY OF QUINHYDRONE

THE structure of quinhydrone has been the subject of extensive investigations. Majority of the experimental evidence is against the view advocated by Willstätter and Piccard that the hydroxyl groups of the benzenoid component of quinhydrone is linked co-ordinately to the carbonyl oxygen of the quinonoid component. Pfeiffer[2] regards quinhydrone as an additive compound with its components held together by residual valencies of the nuclei. Another view of more recent origin is that in the compound the two components are held together due to the interaction between the strongly polar quinonoid groups and the anisotropic, polarisable quinol nucleus. This view is supported by X-Ray analysis of crystals of quinhydrone in which discrete existence of quinonoid and quinoloid units has been shown.[3] A mechanism of how the union is affected is obvious on the above view. The polar quinonoid groups induce corresponding moments in the quinol nucleus and the union is thus affected by the electrostatic interaction between the permanent and induced moments. A similar view has been put forward in case of molecular compounds of sym. Trinitrobenzene.[4] The 'London' Forces thus involved are intermediate between van der Waals's forces and true covalencies. Such weak electrostatic interactions between the two components as in the case of quinhydrone should not effect the magnetic susceptibilities of the two components largely and it should be expected that the molecular magnetic susceptibility of quinhydrone should not differ very much from the sum of the molecular magnetic susceptibilities of quinone and quinol. This should particularly be true in case of quinhydrone since both the components are symmetrical with respect to the substituent groups.

The magnetic susceptibilities of quinone, quinol and quinhydrone were determined by Palacios and Froz,[5] and their results showed that molecular magnetic susceptibility (χ_m) of quinhydrone differs considerably from the sum of the molecular susceptibilities of quinone and quinol. We have, therefore, undertaken the determinations of carefully purified samples and the results are tabulated in Table I. The determinations were made on a modified form of Guoy's Balance. The working of the apparatus was checked by determining χ (mass susceptibility) of a number of substances whose values are known very accurately, *e.g.*, potassium chloride, sodium chloride, benzene, alcohol, etc. Water was taken as reference substance with $\chi = -0{\cdot}720 \times 10^{-6}$. The results were correct within 0·7 per cent. of the accepted values.

TABLE I

Substance	M.P.	Molecular weight	$-\chi \times 10^6$ Mean of 3 concordant readings	$-\chi_m \times 10^6$	$-\chi_m 10^6$ Reported by Frozand Palacios
1. *p*-Benzoquinone	117°	108	0·333	35·96	33·3
2. Hydroquinone (Quinol)	171°	110	0·601	66·11	64·58
3. Quinhydrone	171°	218	0·468	102·05	84·2

The sum of the molecular susceptibilities of quinone and quinol is thus $-102{\cdot}07 \times 10^{-6}$ which is nearly equal to χ_m for quinhydrone ($= -102{\cdot}05 \times 10^{-6}$).

The results support the view about the structure of quinhydrone that the two components are held together in the compound by weak electrostatic forces.

However, it should be clear that this agreement between the sum of χ_m of components and χ_m of the molecular compound may be true in this case only, while, in other similar cases, where the resultant compound may be more or less symmetrical, the diamagnetic susceptibility of the compound may be greater or lesser than the sum of the components.

The results on other similar molecular compounds of *p*-quinone and symmetrical Trinitrobenzene will be published shortly.

Department of Chemistry,
Government College, SUNDER LAL.
Lahore, NOOR-UL-HAQ KHAN.
November 4, 1944.

1. Willstätter and Piccard, *Ber.*, 1908, **41**, 1458; A, 1908. i, 475. 2. Pfeiffer, P., and collaborators, *Annalen*, 1924, **444**, 241–64, 1914, **404**, 1-20. 3. Stuart Anderson, *Nature* 1940 **140**, 583–84. 4. Fevre, R. W. L., *Trans. Faraday Soc.*, 1937, **33**, 210 5. Palacios, J., and Froz, O. R., *Anal. Fis. Quim.*, 1935, **33**, 627–42.

A NOTE ON *HELIOTHIS ARMIGERA* HUBN., AS A PEST OF PEA (*Pisum sativum*)

Heliothis armigera Hubn. (*Chloridea obsoleta* F.) is well known as a pest of various crops. It occurs in America as a cotton ballworm. Fletcher (1914) describes it as a pest of red-gram, Bengal-gram, groundnut, maize (cob), tobacco (seed capsules), ganga (leaves and capsules), safflower (capsules), etc. The writer finds it in Calcutta as a borer of pea-pods, destroying the cotyledons. The only other record of its infestation of pea-pods was from Lyallpur. So far, however, its life-history in pea has not been reported.

This pest was collected from pea-pods obtained from local markets and was reared in the laboratory. The larvæ collected from pea-pods were kept separately in separate glass-vials plugged with cotton, so as to note their individual growth and period of pupation. They were fed with pea-pods. The larvæ were voracious eaters and occurred in great abundance during the months of January and February 1944. Their number decreased from March onwards. The maximum length of a full-fed larva reared in the laboratory was 3·6 cm. They were bright-green in colour,

which showed considerable variation. The larvæ pupated within the vials during the months of February and March. No cocoon was formed, but the pupæ were found to be held by some fine thread-like structures, probably formed by the secretions of the silk-gland. The pupæ were dark-brown in colour and their lengths varied from 1·6 to 1·9 cm. The duration of pupal period varied from 8 to 12 days.

In course of rearing this pest the writer also came across the following species as infecting pods:—(1) *Polyommatus boeticus* L., during the months of December, January and February and (2) *Etiella zinckenella* Tr., during the months of February and March. The last mentioned species is regarded as a minor pest of pulses by Fletcher (1914), but since it occurred in sufficient number, it may be regarded as a major pest like *Heliothis armigera* H., the incidence of the two pests taking place in different periods of the pea-season.

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November 4, 1944.

1. Ayyar, R., *A Handbook of Economic Entomolgy*, 1940. 2. Fletcher, T., *Some South Indian Insects*, 1914. 3. Hampson, G., *Fauna of British India*, 1894, Moths 2. 4. *Rept. Proc. 3rd. Ent. Meeting, Pusa*, 1919, 1, 60.

THE THERMAL DECOMPOSITION OF MERCURIC FULMINATE

HOITSEMA[1] obtained a yellowish product on heating mercuric fulminate to 132° C. which could be heated to higher temperatures without explosive decomposition. He believed that this residue was mercuric oxide and, strangely enough, he found in the gaseous products of decomposition no cyanogen, no carbon dioxide and no carbon monoxide but only oxygen in an almost pure state. Hess and Dietl[2] found that when 0·5 gm. of fulminate was heated in a test tube at 90-95° C. for 75½ to 97 hours it was transformed into a brownish yellow, non-explosive, difficultly combustible isomerisation or polymerisation product with no change in crystal structure. Langhans,[3] working with 15 gm. of fulminate heated in a cylindrical Passburg vacuum drier maintained at 90° C. for 100 hours, obtained the brownish yellow transformation product with similar characteristics, made an exhaustive qualitative study of its chemical properties and named it "Pyrofulmin". Although he never got consistent results on analysing the solid residues obtained from several runs, he concluded from his analytical figures that carbon and oxygen alone disappeared partly and, from his highest values, he worked out the empirical formula of the compound as $Hg_4N_7C_8O_7$. If this formula were correct it is evident that there would have to be some nitrogen in the evolved gases.

Farmer[4] was the first to study quantitatively the velocity of decomposition of mercuric fulminate *in vacuo* at temperatures between 60° and 90° C. using 1 to 2 gm. of the substance. He found that the velocity curves are of an abnormal type with an initial quiescent period, decomposition setting in somewhat abruptly, proceeding at first with a nearly constant velocity, which increases slightly until the decomposition ultimately ceases almost abruptly. The main relevant conclusions from his experiments are:—

(i) The temperature coefficient within the temperature interval is 1·12 per degree centigrade or 1·75 per 5° C., a fact of fundamental importance in the drying and storage of this explosive and its mixtures.
(ii) The total quantity of evolved gas at 80° C. per gram varies from 44·3 to 48·5 c.c. which corresponds in the mean with 0·58 mol. per mol. of fulminate.
(iii) The evolution of gas is proportional to the quantity of fulminate.
(iv) The gas evolved is nearly pure carbon dioxide although on prolonged heating gases unabsorbed by soda lime were given off.
(v) The residue from the decomposition believed to be a solid autocatalyst is a brown, insoluble material, particles of which retained their original shape.

Garner and Hailes[5] using a more elaborate and refined technique and working with single crystals, 1 to 5 mgms. in weight, followed the decomposition and detonation *in vacuo* in the temperature range 100° to 120° C. They found that *in vacuo* the thermal decomposition passes into detonation at 105° to 115°C. and that below the ignition temperature the decomposition occurs in three stages:—

(i) A quiescent period;
(ii) a period of acceleration of rate of reaction for which the logarithmic relationship, $\log (dp/dt - dp_0/dt) = kt +$ constant holds; and
(iii) a region where the first order equation applies.

Stages (ii) and (iii) occur in crushed and ground fulminate also. The critical increment of the thermal reaction is approximately 30 kg. cal. and the volume of the total gas evolved in c.c./gm. lies between 52 and 55 c.c.

The writer has studied the decomposition of several batches of mercuric fulminate of purity 99·3 ± 0·2 per cent. at 100° and 120° C. using 0·1 gm. of the material in the apparatus developed and standardised by Farmer (*loc. cit.*) for the examination of the vacuum stability of certain types of high explosives. A preliminary critical examination with four stability tubes at 100° C. with 0·1 gm. of the explosive in each from a small portion of the same batch has revealed that:—

(i) apart from small variations in the individual rates, especially in the early stages, owing probably to differences in total effective surface, the general course of the decomposition is substantially the same in all;
(ii) the decomposition is nearly complete in about 32 hours but, thereafter a slow but continuous evolution of small quantities of gas takes place for a

further period of 64 hours after which no more gas is evolved over a period of 48 hours;

(iii) no further gas evolution is noticeable by keeping these tubes at temperatures 120-125° C. for periods up to 120 hours;

(iv) the total volume of gas evolved is $5{\cdot}21 \pm 0{\cdot}04$ c.c. at N.T.P. which works out to 2 molecules of gas for every three molecules of fulminate.

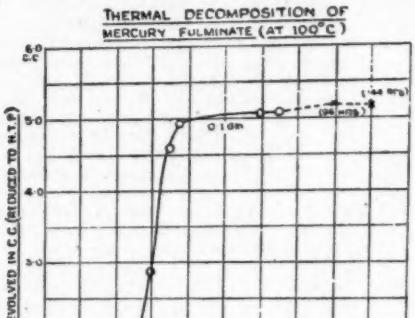

FIG. 1

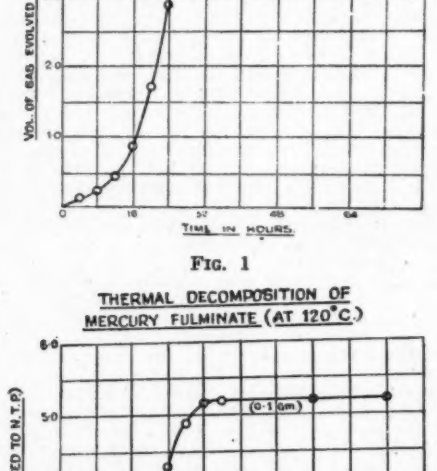

FIG. 2

A systematic error of approximately —0·04 c.c. attributable, under the conditions of experiment, to thermal expansion of the heating tube has been located and all the values of final gas volumes reported here are automatically corrected for this by taking the pressure measurements after cooling the system to laboratory temperature. Figures 1 and 2 show the average results of the preliminary runs at 100° and 120° C. The curves are substantially similar to those obtained by Farmer and by Garner except for the final stages and for the practical absence of the initial quiescent period. The probability of explosion is nil with 0·1 gm. at 100° C. and 0·03 gm. at 120° C. while it appears to be 3 in 4 at the higher temperatures with 0·1 gm. of the material and seems to centre round the time of half decomposition. The temperature coefficient and the critical increment of the time of half change are 1·75 per 5° C. and approximately 32 Kg. cals. respectively which are in substantial agreement with the results of previous workers. A number of other batches examined behaved in the same way, yielding the same quantity of gas within the range of experimental accuracy.

Analysis of the gas carried out with the Ambler[6] portable type of apparatus on samples taken at the final stage showed that it consists entirely of carbon dioxide and carbon monoxide in the ratio of 3:1. This was further

FIG. 3

confirmed in a special run by a proportionate pressure fall in the manometric limb of the apparatus under test which contained a short length of saturated caustic potash solution on the top of the mercury column, while a blank, empty tube, similarly got up, allowed for extraneous factors.

The solid residue retained the original crystalline shape and consisted of brown shining crystals (Fig. 3). On analysis this substance has been invariably found to contain $77{\cdot}57 \mp 0{\cdot}2$ per cent. mercury using the method described by Treadwell[7] after dissolving it in

warm moderately strong sulphuric acid and cautiously diluting it just before precipitating the sulphide. A complete elementary analysis has not been attempted as yet owing partly to the difficultly combustible nature of the substance but chiefly to the relatively little information that is likely to accrue from it. A molecular weight determination by the usual methods appears to be out of the question because of the insolubility of the substance in water and all the organic solvents tried. It is, however, hoped to continue the work, as soon as peace is declared, with a view to determining directly the heat of combustion of the substance in a calorimetric bomb and to studying also its crystal structure. The result so far obtained indicate that the substance is definitely homogeneous and that it is most probably a single chemical compound stable at least up to 125° C. with the empirical formula $Hg_6O_5C_8N_{10}$, obtained presumably by 3 molecules of fulminate polymerising in a manner characteristic of cyanogen compounds and at least two such polymers decomposing together giving rise to the products below:—

$$3\,Hg(ONC)_2 \longrightarrow \underset{\text{hypothetical \& unstable}}{Hg_3(O_2N_2C_2)_3}$$

$$2\,Hg_3(O_2N_2C_2)_3 \longrightarrow \underset{\text{Brown residue}}{Hg_6O_5C_8N_{12}} + 3CO_2 + CO$$

The compound formulated would have a mercury content of 77·77 per cent. which is in fair agreement with the value experimentally obtained. It is proposed to name this substance mercuric pyrofulminate or shortly "pyrofulmin", after Langhans. It would appear that this compound would open out a new type of morphological relationship, which for want of a better word may be described as pseudo-polymeric-isomorphism. It is considered that any further theorising regarding the molecular nature of the compound should await the results of the work contemplated.

The author wishes to place on record his gratitude to Mr. M. D. Owen, the Assistant Inspector, and to Dr. H. R. Ambler, F.R.I.C., the Chief Inspector of Military Explosives, for much valuable criticism, encouragement and grant of permission and facilities to do the work and to the Director of Armaments, India, for grant of permission for publication.

Inspectorate of Military Explosives, Kirkee, *November* 7, 1944.

P. Y. Narayana.

1. Holtsema. Z., *Physikal. Chem.*, **1896, 21,** 137. 2. Hess and Dietl, Muspratt's, 'Enzyklopädisches Handbuch der technischen Chemie," **1900, 7, 968.** 3 Langhans, *Z. ges. Schiess—u. Sprengstoffw.*, **1922, 17,** 9, etc. 4. Farmer, R. C., *J. Chem. Soc*, **1922 121,** 174, *Ibid.*, **1920, 117, 1432, 1603.** 5. Garner, W. E., and Hailes, H. R., *Proc. Roy. Soc.*, **1933, A, 139, 576.** 6 Ambler, H. R., *J. Sci. Instr.*, **1931, 8, 369** see also Lunge and Ambler, "Technical Gas Analysis," **1934, 81.** 7. Treadwell, F. P., and Hall, W. T., "Analytical Chemistry." Vol. II, 6th Edn., **1924, 172.**

Note.—The approximate density of the decomposition product has been determined in carbon tetrachloride and in diamylphthalate at 28° C. and found to be 5·1. Mercuric fulminate, under similar conditions, has given a value of 4·4.

CANTHARIDIN CONTENT OF *MYLABRIS MACILENTA* BEETLES

In the search for a suitable substitute for 'Cantharis Pulvis', an item occurring in the Priced Vocabulary of the Government Medical Store Depots in India, and in fair demand for the preparation of a number of medicinal preparations, the Director (Drugs & Dressings), Directorate-General of Supply (Medical Division), New Delhi, sent to the Biochemical Standardisation Laboratory, Calcutta, a specimen containing blister beetles for analysis and opinion.

The analytical data according to the B.P.C. (1934) method were found to be as follows:—

Analytical Data:

(1) Loss on drying at 100° C.—15 per cent. (B.P.C. Mylabris—volatile matter at 100° C. about 13·5 per cent., U.S.P. XI and B.P.C. Cantharis—not more than 10 per cent.).

(2) Ash—6·1 per cent. (B.P.C. Mylabris—about 6·5 per cent.; B.P.C. Cantharis —about 8 per cent.).

(3) Fat—13·1 per cent. (B.P.C. Mylabris—present; B.P.C. Cantharis—about 12 per cent.).

(4) Cantharidin—1·3 per cent. B.P.C. Cantharis—not less than 0·6 per cent.; commercial varieties—0·4 to 0·8 per cent.; B.P.C. Mylabris—1 to 2·3 per cent.; U.S.P. XI Cantharidin—not less than 0·6 per cent.).

It was concluded that the cantharidin content of the sample of beetles satisfied the standard as specified by B.P.C. or U.S.P. for cantharidis (*Cantharis vesicatoria*) or B.P.C. Mylabris (Synonym—Chinese Cantharidis). The sample was, therefore, considered suitable for use as a substitute in place of 'Cantharidis Pulvis'.

Interest was created in the identity of the beetles as these differed significantly in macroscopic and microscopic characters from either *Cantharis vesicatoria* Latr. of foreign origin or Mylabris species—*M. sidæ* Fab., *M. chicorii* Linn., and *M. Pustulata Thumb*—commonly seen and described as occurring in India and China. Further enquiry revealed that these beetles were collected during hot weather from areas in the United Provinces in the neighbourhood of the Bareilly District and were identified from two independent sources as a variety of Mylabris—*M. macilenta*.

Iyer and Guha[1] obtained about 2·3 per cent. total cantharidin and 1·35 per cent. of free cantharidin from dried *M. pustulata* beetles by employing a modified method of Dieterich.[2] By employing the ordinary B.P.C. method of assay, the cantharidin content of dried *M. macilenta* beetles came to 1·3 per cent. By employing a recent and more satisfactory method of extraction (Bodenstein[3]), the cantharidin content was found on an average (5 determinations with separate random samples) to be 1·8 per cent. The m.p. of the material (final residue) was recorded as 210-212° C. (uncorr.). Though recrystallisation from alcohol was attempted, the sharp m.p. of 212° C. of pure cantharidin crystals was not obtained. However, for all ordinary purposes, it would be correct to state that *M. macilenta* beetles con-

tained a cantharidin content of 1·8 per cent. For want of material, comparison with *M. pustulata* was not possible by the Bodenstein method (*loc. cit.*), but another variety of beetle gave a very much lower yield.

Those interested in cantharidin may look up to *M. macilenta* beetles to supply their needs during wartime certainly and possibly also later, as the Spanish fly, from all accounts, contains a definitely lower percentage of cantharidin.

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November 7, 1944.

1. Iyer and Guha, *J. Ind. Inst. Sci.*, 1931. **14A**, 31. 2. Dieterich, *J. Pharm.*, 1893 (5) **27**, 375; *J.C.S., A.*, *i.* 1893, 600. 3. Bodenstein, *Analyst* 1943, **68**, 238.

A PRELIMINARY STUDY OF THE BACTERIAL FLORA ASSOCIATED WITH SULPHUR DEPOSITS ON THE EAST COAST (MASULIPATAM)

THE soil collected from the Masulipatam area was first passed through Molisch's Enrichment Medium composed of Peptone 5 gms., Dextrin or Glycerin 5 gms., Seawater 1,000 ml., and Agar 18 gms., and with a pH of 7·6. The slants were inoculated with the samples of soil and incubated at 30° C. for 72 hours. Profuse growth was observed after 24 hours. This culture was then transferred to McGreger and Skene's medium (composition: ammonium sulphate 0·75 gm., magnesium sulphate 0·05 gm., potassium dihydrogen phosphate 0·05 gm., potassium chloride 0·05 gm., calcium nitrate 0·01 gm., sodium chloride 27·0 gms., calcium carbonate 10·0 gms., and distilled water 1,000 ml., pH 7·6). This is a synthetic medium which is expected to promote the growth of only the obligate or facultive autotrophs. The medium (50 ml.) was placed in 150 ml. Erlenmeyer flasks, sterilised and incubated at 30° for 15 days. The growth on this medium was poor and some flasks showed no growth at all.

Plating trials in McGregor and Skene's agar medium followed by 48 hours' incubation at 30° yielded distinct colonies. They were transferred to McGregor and Skene's agar slants. Three such passages through a completely synthetic medium were expected to eliminate all saprophytic contaminants. The organisms thus isolated appeared to constitute a pure culture as judged by microscopic characters and reaction to staining.

From a total of five samples of soil 14 distinctive stock cultures were obtained. They were subjected to the following studies:—

Morphological: (*a*) *Microscopic observation.*—The culture was first passed through a liquid medium of McGregor and Skene's composition and 24-48 hour culture studied for motility and Gram staining. (*b*) *Growth.*—Growth on nutrient agar, wort agar, McGregor and Skene's agar and Van Delden's sodium lactate-asparagin agar were studied.

Biological.—Since the temperature of incubation and pH of media were maintained as nearly the same as occurred in soil, no special trials were made in this connection. Observations were, however, made in all solid cultures as to their ærophilic, micro-ærophilic or anærophilic nature.

Biochemical: (*a*) *Tolerance of H_2S.*—Two sets of Erlenmeyer flasks with necessary controls containing McGregor and Skene's medium were inoculated with the cultures. To one set 5 c.c. of a saturated solution H_2S in water was added on alternate days, and the other set incubated without any such addition. Most of the cultures survived the first two doses only. (*b*) *Nitrate reduction.*—The cultures were inoculated into a medium to test for their nitrate-reducing properties. After 48 hours' growth the reduction was tested by Glossway's method. A control for nitrate and one for nitrite was also run. (*c*) *H_2S production.*—The organisms were inoculated into nutrient agar to which 0·1 per cent. of a 10 per cent. lead acetate solution had been added. None of the cultures showed any production of H_2S.

Thiosulphate reduction.—Waksman's thiosulphate medium composed of sodium thiosulphate 5 gms., potassium dihydrogen phosphate 3 gms., ammonium chloride 0·1 gm., magnesium chloride 0·1 gm., calcium chloride 0·25 gm., and distilled water 1,000 ml., was inoculated and incubated for 72 hours. An aliquot was titrated against standard iodine solution using starch as an indicator. The uninoculated flasks served as the control. None of the cultures had utilised any thiosulphate.

In interpreting the data given in Table I the following observations are relevant: (1) The area from which the soil was collected is washed by the backwaters of the sea and is submerged under stagnating water during the monsoon. (2) During the dry season the soil cracks and deep fissures are created. (3) At a depth of 3 feet or more the soil strongly smells of sulphuretted hydrogen. (4) The soil is associated with layers of red ochre consisting largely of ferric oxide. (5) In places where watersprings can be dug out a vigorous evolution of gas (later identified as marsh gas) is observed. The most significant circumstance was the occurrence of H_2S in the deeper strata of the soil and it was thought that some of the organisms might require its presence for their metabolism.

Sulphates constitute an important source of H_2S. Since the transformation of sulphate to H_2S is uneconomical to microbial life in that this change does not give them any energy surplus, the phenomenon is not common. However Beijerinck[1] reported Spirillum desulpuricans and Vandelden[2] reported microspira æstuarii. The oxygen liberated during the reduction of sulphate by these organisms is used up in oxidising some organic matter as was shown by Van Delden who used sodium lactate for the purpose. At room temperature the reduction was brought about in 5-10 days. Elion[3] has reported another organism Vibrio thermodesulphuricans able to bring about the reduction in 12 hours incubated at 50° C. The production of H_2S from organic matter is a phenomenon of more frequent occurrence and a large number of Saprophytes are known to achieve this. The absence of any production

Culture No.	* Microscopic characters and gram staining	† Growth on media	‡ Nitrate reduction
1	Thin long rods; some sporulated; motile; −ve	N++; W+++; M.S.+++; V.D.++++	++
2	Short rods; nonmotile; −ve	N++; W++; M.S.++; V.D.++	+
3	Long spirally coiled rods; nonmotile; −ve	N++; W++; M.S.++; V.D.++	++++
4	Thin long rods; nonmotile; +ve	N++++; W+++; M.S.++++; V.D++++	+
5	Short to medium rods motile; +ve	N++++; W++++; M.S.+++; V.D.+++	+++
6	Thin long rods; nonmotile; −ve	N+++; W+++; M.S.+++; V.D.+++	+
7	Thick short rods; motile; +ve	N+++; W+++; M.S.+++; V.D.+++	+
8	Thick short rods almost of size of yeasts; nonmotile; −ve	N+; W+; M.S.+++; V.D.+++	+
9	Thin long rods with 3–4 granules in the cells; motile; +ve	N++; W+++; M.S.++; V.D.+++	+
10	Thin long rods; nonmotile; −ve	N+; W++; M.S.+; V.D+++	++
11	Thin long rods; motile; +ve	N++; W++; M.S.++; V.D.++	+
12	Thin rods, motile (?) +ve	N+++; W+++; M.S.+++; V.D.+++	++
13	Short thin rod; motile; −ve	N+++; W+++; M.S.+++; V.D.+++	+
14	Medium thin rod; motile; −ve	N++++; W+++; M.S.+++; V.D.+++	++++

* Short 0·5–2μ; Medium 2·0μ–4·0μ; Long 4μ upwards.

† N—Nutrient agar; W—Wort agar. M.S.—McGregor and Shene s agar; V.D.—Vandelden's sodium lactate-asperagin agar. + Slight growth; ++++ Profuse growth.

‡ + Slight pink; ++++ Intense red.

(No H_2S produced by any culture; No thiosulphate utilised and H_2S not toterated.)
All cultures are aerophilic.

of H_2S by any one of the 14 cultures is probably due to the elimination of Saprophytes inherent to the methods of isolation described in the earlier portions of this paper. These Saprophytes are usually anærobes or microærophilis and perhaps therein lies the significance of the nitrate reducers which create a favourable environment for the saprophytes to thrive.

In the formation of elemental sulphur two well-defined stages appear to be involved. First, the production of H_2S by the deeper layers of the soil and second the oxidation of H_2S to yield sulphur. It is suggested that the reactive nitrite liberates sulphur from the H_2S thus formed—$KNO_2 + 3\ H_2S = KOH + 3\ S + NH_3 + H_2O$. The existence of powerful nitrite formers among the bacteria so far isolated lends significant support to the view that the above reaction may be operative in those strata where sulphur deposition occurs.

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November 7, 1944. M. Sreenivasaya.

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PHOTOCHEMICAL ANALYSIS

Estimation of Ferric Salts

Recently Gopala Rao and Ramacharlu[1,2,3] have introduced a new technique into analytical chemistry. They are the first to employ the photochemical action of light as an aid to quantitative analysis. We have now found that ferric salts can be estimated with considerable ease and accuracy by the same technique, making use of the photochemical reaction between ferric salt and sodium oxalate in aqueous solution. In the dark, at laboratory temperatures, there is no appreciable reaction but on exposure to sunlight ferric salt is rapidly reduced to the ferrous salt. The results in the following table show that the reaction goes to quantitative completion in about ten minutes.

Table I

20 mls. of ferric alum solution (approx. N/20) + 20 mls. of N/10 sodium oxalate + 10 mls. of 4 N sulphuric acid

Time of exposure to sunlight	Amount of ferric iron reduced
5 minutes	0·036 gram
10 ,,	0·053 ,,
20 ,,	0·053 ,,
30 ,,	0 053 ,,
40 ,,	0·053 ,,
100 ,,	0·053 ,,

The reaction mixture is exposed to sunlight in a glass-stoppered wide-mouthed bottle or a Monax conical flask for the requisite time and the ferrous salt formed is estimated by titration with a standard solution of sodium vanadate using diphenyl amine reagent as the internal indicator, according to the method of Gopala Rao and Viswanadham.[4] It must be noted that dichromate cannot be employed for this titration, as the presence of oxalate interferes in the titration of ferrous salt by dichromate.[5] The standard solution of sodium vanadate is easily prepared and can be preserved for many months without alteration.[4]

We have made numerous estimations by the photochemical method now proposed, and the few typical results given below will show that there is good agreement between the amount of ferric iron determined by the photochemical method, and that found by the usual method—reduction with stannous chloride, etc., and the subsequent titration with a standard solution of potassium dichromate.

TABLE II

$\times$ *mls. of ferric alum solution*
$+\times$ *mls. of sodium oxalate solution*
$+\frac{\times}{2}$ *mls. of 4 N sulphuric acid*

Exposed to sunlight for 30 minutes

Amount of ferric iron taken	Amount of ferric iron found by the photochemical method
0·01385 gram	0·01372 gram
0·02681 ,,	0·02681 ,,
0·04271 ,,	0·04271 ,,
0·05327 ,,	0·05327 ,,

We have also found that the presence of hydrochloric acid or chlorides does not interfere with the photochemical method.

It will be realised that the photochemical method now proposed for the estimation of ferric salt is much more simple, easy and elegant than any of the other methods adopted at the present time..

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1, Gopala Rao, G., and Ramacharlu, P. T., *Curr. Sci.* 1942, **11**, 102 2 —, —, *Proc. Nat. Inst. Sci. (India)*, 1942, **8**, 383. 3 —, —, *Ibid.*, 1943, **9**, 67. 4. —, and Venkanadham, C. R. *Curr. Sci.*, 1944, **13**, 180. 5. —, —, *Ibid.*, 1943, **12**, 327.

A PRELIMINARY NOTE ON THE OCCURRENCE OF SULPHUR NEAR MANJHARA IN THE DEHRA DUN DISTRICT, UNITED PROVINCES

IT needs no emphasizing that sulphur is a mineral of great industrial importance and strategic value. Any occurrence, either large or small, is worthy of record. About one mile and 1½ furlongs, east of north of the sulphur spring of Sahasradhara[1] (30° 23′ 10″: 78° 7′ 48″), two streams join together to form a large stream. The eastern stream is called the Kali *Gad*. A little over one furlong north of the confluence on the right bank of the western stream, a large deposit of gypsum occurs associated mainly with an almost black dolomite, which is highly jointed and sometimes crumbles into a cindery gravel. Sulphur is found here (30° 24′ 15″ : 78° 8′) associated with gypsum and black dolomite.

The country-rock, in which the sulphur occurs, is very dark grey in colour. The weathered portion has a very rough, irregular surface. It has practically no reaction with dil. HCl but when treated with heated dil. HCl, it has a brisk effervescence and thus appears to be dolomite. The colour of the streak is grey and it is noteworthy that the rock on breaking or powdering emits a strong smell of H_2S. An average specific gravity of two specimens (containing very fine veins of gypsum) is 2·61.

This dolomitic rock, apart from the main gypsum deposit, is traversed by a network of white veins of gypsum. Associated with these white veins are to be seen small crystals or fine patches of native sulphur. In the white veins of gypsum, sometimes very fine stringers of yellow sulphur are to be observed. At times it appears that the gypsum has been deposited in the cavities of dark dolomite and sulphur is found associated with most of the small patches of gypsum. Sulphur occurs either in crystals or fine patches in the dolomite rock. It was found on breaking that the mineral occurs in the interior also. Sometimes, when a block of the dolomite was broken into a number of pieces it was observed that each piece had some sulphur associated with it. It, therefore, occurs associated with both gypsum and the dolomite rock and from its mode of occurrence it appears that the mineral was deposited in the native state along with the gypsum in the dolomite rock.

It is difficult to say anything about the exact commercial importance of this occurrence. Sulphur has been known to occur in fairly large quantities associated with gypsum. I was informed that during the quarrying of gypsum, small pieces of sulphur were found. Mr. S. Rai Pathak informed me that some of the pieces of sulphur weighed more than a pound. Mr. Pathak is an old resident of Dehra Dun and has been associated with the quarrying of gypsum in this area for a long time.

It has already been mentioned that the dolomite rock on breaking and powdering emits a very strong odour of H_2S. In this connection it may be noted that sulphur springs occur in this neighbourhood. One of them occurs above the left bank of the stream and opposite the place called Sahasradhara. This spring has a copious discharge so that a tiny stream issues forth from huge blocks, some of which are of the size of a small hut. I found that since my last visit two small tanks have been constructed for the bathing of the public. There is a fine white deposit of milk of sulphur and gypsum at the bottom of the tanks. The water smells strongly of H_2S. This is evidently a subterranean or a deep-seated spring. By the action of these circulating solutions on limestone, the deposits of gypsum of this area have been formed. The odour of hydrogen sulphide in the dolomite, perceived on breaking or powdering, is also due to the percolation of these solutions into the rock.

Sulphur, therefore, occurs at this locality in three forms: (i) as gypsum, (ii) in the native state, (iii) also in the dolomite rock. Besides, the occurrence of sulphur in the waters of the spring at Sahasradhara is also to be noted.

The locality is easily accessible and is only a few miles from Dehra Dun. In the dry season

motor lorries can ply as far as Sahasradhara and the main locality is hardly three miles by pony road from it.

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November 8, 1944.

1. On the one inch sheet 53J/3 this place is spelt as Sansa Dhara but the correct spelling is Sahasradhara.

CATALYSIS IN VOLUMETRIC ANALYSIS

Estimation of Potassium Persulphate

IF a reaction is to serve as the basis of a volumetric analytical process, it must be a very speedy one. While ordinarily very fast reactions only are selected for the purpose, some of the slowly occurring reactions have also been utilized on account of their convenience otherwise, the speed of reaction being increased by elevation of temperature. Only a few cases are on record where the speed of a reaction is increased for analytical purposes by the use of a suitable catalyst. Recently Gopala Rao and Ramacharlu[1] have employed sunlight or artificial light to accelerate a reaction so that it becomes suitable for purposes of quantitative analysis. It appeared to us that the phenomenon of catalysis can be utilized to a fuller advantage in volumetric analysis than has been the case hitherto. We have found that a suspension of cuprous iodide in water serves as an excellent catalyst for the reaction between potassium persulphate and potassium iodide and that the reaction so catalysed at room temperature is quite suitable for the iodimetric estimation of persulphate. The iodimetric method has the advantage that it is simple and accurate, giving directly a measure of the oxidizing power of persulphate. The methods now in use, with the exception of the iodimetric method of L. von Zombory,[2] are cumbrous. The alkalimetric method is based on the well-known reaction $2S_2O_8 + 2H_2O = 4HSO_4 + O_2$ which takes place rapidly at 100° C. This method is not suitable for the estimation of ammonium persulphate, as nitric acid and nitrogen are also obtained due to secondary reactions. Moreover, the method is vitiated by the presence of bisulphate in the original sample. The method of Le Blanc and Eckardt is an indirect one, being based on the fact that persulphates oxidize ferrous sulphate, the speed of the reaction being considerable when the latter is present in excess.

The cuprous iodide catalyst used in our experiments was prepared by adding a slight excess of potassium iodide to a known quantity of pure copper sulphate (Merck, A.R. sample) in dilute solution, washing the precipitate obtained repeatedly by decantation with water until free from all traces of free iodine. The cuprous iodide thus prepared was suspended in water and the suspension made to a known volume and preserved in a wide-mouthed glass-stoppered bottle. This was found to be quite stable for several months, no trace of iodine or cupric salt appearing. The suspension used in our experiments contained approximately 0·015 gm. of cuprous iodide per millilitre. The results recorded in Table I demonstrate the catalytic action of cuprous iodide.

TABLE I

15 ml. of potassium persulphate solution + 20 ml. of 0·125 Molar potassium iodide solution
Amount of persulphate taken = 0·1014 gm.

Time in minutes	Amount of persulphate reacted	
	Without catalyst	With 2 ml. of cuprous iodide suspension
10	0·01624 gram	0·08672 gram
20	0·02581 „	0·08692 „
40	0·03843 „	0·08734 „
60	0·04591 „	0·08816 „
80	0·05267 „	0·08869 „
100	0·05603 „	0·08909 „

The catalytic action of cuprous iodide has been applied to the volumetric determination of persulphate in the following manner. 20 mls. of the persulphate solution are placed in a glass-stoppered bottle or Erlenmeyer flask, 20 mls. of potassium iodide solution (M/2) are added, followed by 5 mls. of the cuprous iodide suspension. The bottle or flask is kept stoppered for ten to fifteen minutes and the iodine liberated is titrated with a standard solution of sodium thiosulphate. The results are given in column 1 of Table II. These compare very favourably with those in column 2, the latter being obtained by the method of Zombory.[2] For the estimation of persulphate by our method, it is desirable to have the iodide at a concentration, 20 to 50 times that of the persulphate.

TABLE II

Amount of Persulphate Found

Authors' method (15 minutes)	Zambory method (30 minutes)
0·13340 gram	0·13340 gram
0·10100 „	0·10100 „
0·03684 „	0·03656 „
0·05286 „	0·05309 „
0·01823 „	0·01828 „

Thus it will be observed that our method requires a much shorter time than that of Zombory. We have found that silver, mercuric, cerous, cobalt, nickel and manganous salts do not catalyse the reaction between persulphate and iodide either in neutral or acid medium, while ferrous and ferric salts are good catalysts.

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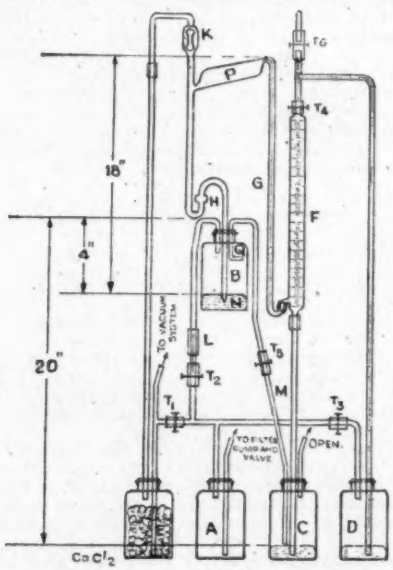
1. Gopala Rao, G., and Ramacharlu, P. T., *Curr. Sci.*, 1942, **11**, 102; *Proc. Nat. Inst. Sci.* (India), 1942, **8**, 383; *Ibid.*, 1943 **9**, 67. 2. Zambory, L., *Von. Z. Anal. Chem.*, 1928, **73**, 217.

AUTOMATIC TÖPLER PUMP

THE following description is given of an improvised automatic Töpler pump which has proved successful in use. In view of the shortage of good glass stopcocks, pinchcocks have been used throughout. The bottles and tubings employed are those commonly employed in a laboratory. The glass-blowing has been reduced to a minimum. F is taken from a broken burette. In the following design the automatic system of the Töpler is worked by a filter pump.

N H K P G is one piece of glass consisting of the usual Töpler P and valve K, H a bulb for trapping creepage, N, a constricted end to obviate knock. The bend at Q prevents splash of mercury and consequent creepage of air into P. A 1-1½ mm. quill tubing serves well for G and is more flexible than the usual capillary.

During the upstroke, mercury follows the gas from P *via* G into F and then enters C. The level in C rises, seals the bottom end of M, thereby closing B from the atmosphere. The filter pump, running continuously, is now able to evacuate B *via* A and the leak T_5; with the fall of pressure in B, all the excess mercury that had flown into C, is lifted back to B *via* M. Also the mercury in P comes



AUTOMATIC TÖPLER PUMP

down, whereby E and P are connected ready for the upstroke. When all the excess mercury is lifted back to B, the bottom end of M is open, whereby air enters B to atmospheric pressure. This starts the upstroke in P and the cycle repeats. During the upstroke with the bottom end of M open, and the small leak T_5, the pressure in B is substantially atmospheric.

To start the pump, T_5 and T_6 are closed, T_1, T_3, T_2 and T_4 are opened and the filter pump started. When exhausted to the limit T_1 is closed, T_3 is partly closed and T_5 then opened. The pump starts automatically. To stop the pump, the above procedure is reversed. When E and the experimental system are well evacuated, T_2 may be closed, for collecting larger samples of gas from the pump. T_4 is closed when quantitative measurements of smaller quantities of gases are necessary. F is graduated for the purpose. It may be advantageous in some cases to replace the screw pinch T_4, by a suitable two-way glass tap. T_6 allows sampling of the gas from F. The mercury at the bottom of D serves as a valve during the intermittent action of B. T_5 controls the frequency of strokes. Further reduction in frequency may be effected by a fine-bore capillary tubing L in the line. The various levels marked in the diagram are somewhat critical for smooth and efficient running of the pump.

We are indebted to Dr. H. R. Ambler, PH.D., F.R.I.C., Chief Inspector of Military Explosives, for his valuable suggestions and to the Director of Armaments for permission to publish the note.

Inspectorate of Military Explosives, Kirkee, *November* 15, 1944. B. N. MITRA. G. SIVARAMAKRISHNAN.

ESTIMATION OF PYRIDINE AND AMMONIA IN A MIXTURE IN DILUTE SOLUTIONS

AMMONIUM salts of coal-tar origin often contain traces of pyridine. There has as yet been no entirely satisfactory method of carrying out the estimation of small quantities of pyridine in presence of ammonia. Acidimetric titration fails for want of a suitable indicator as will differentiate pyridine from ammonia, while colorimetric methods, though sensitive, are not accurate enough. Differential electrometric titrations described below, have been found to provide an accurate method for the estimation of pyridine in ammonia.

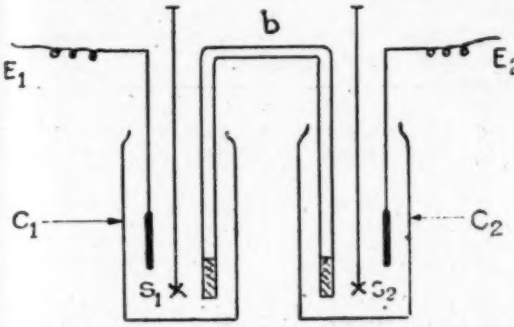
APPARATUS

E_1, E_2 are antimony electrodes, C_1, C_2 titration flasks, S_1, S_2 stirrers, b KCl-bridge with ends plugged with filter paper. Separate burettes containing N/50 acid are used for each titration flask. The stirrers, electrodes and bridge are mounted compactly on a wooden stand which also supports the two burettes. The titration flasks are inserted from below and supported by wooden blocks. E_1 and E_2 are connected through a tap key to the terminals of a millivoltmeter reading directly to 1/5 mv. The tap key is used only momentarily for taking readings which are well repeatable if polarisation is avoided.

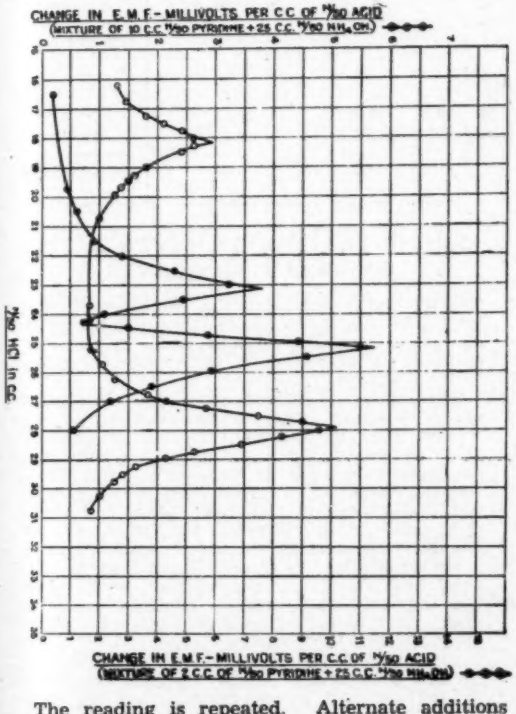
PROCEDURE

The pyridine is separated from the bulk of ammonium salts by distillation with a little alkali. Aliquot portions of the distillate are placed in C_1 and C_2 and the stirrers started. It is generally found necessary to increase the coductivity of these dilute solutions for good working. Purest KCl or NaCl, tested to be

neutral, was found suitable and about 2-10 per cent. may be added in equal quantities to both cells. The millivoltmeter is now read.



To C_1 1 c.c. of N/50 HCl is added, and the millivoltmeter reading again taken. To C_2 1 c.c. of N/50 acid is added from its burette.



The reading is repeated. Alternate additions are made to C_1 and C_2, noting the deflections for every c.c. added.

The deflections per c.c. $\left(\frac{\delta e}{\delta v}\right)$ are plotted against v, the volume of acid added. Typical curves are shown. These curves reveal two characteristic peaks. The difference between the peaks is equal to the quantity of pyridine added. Some results obtained for known mixtures are given below.

The method is independent of arbitrary end points in titrations. Further applications of the method to inspection of weak acids and bases in textiles, paper, rubber, leather and other organic materials are under investigation.

Quantities present in the mixture in c.c. of N/50		Pyridine found in c.c. of N/50		
			By difference between end points with phenolphthalein and	
NH_4OH	Pyridine	By the present method	Bromocresol green	Congo red
25·0	25·0	24·8±0·2	26·0–27·2	26·2–28·4
25·0	10·0	9·8±0·2	12·3–12·9	12·1–13·9
25·0	5·0	5·2±0·2	7·3– 9·1	7·3– 9·5
25·0	2·0	2·1±0·2	4·7– 6·2	4·8– 6·4
0·0	10·0	9·7±0·2	9·5– 9·7	9·0–10·1
0·0	2·0	2·2±0·2	1·9– 2·0	1·8– 2·4

Our thanks are due to Dr. H. R. Ambler, PH.D., F.R.I.C., for his keen interest in the work and to the Director of Armaments for permission to publish it.

Inspectorate of Military Explosives, Kirkee, *November* 15, 1944.

B. N. MITRA.
G. SIVARAMAKRISHNAN.

LINKAGE RELATIONS OF THE *lid* GENE FOR LINTLESSNESS IN ASIATIC COTTONS

THE appearance and the inheritance of the Baroda lintless mutant was reported earlier in this *Journal* (Govande, 1944) when it was shown that this and the Viramgam lintless mutant represent independent mutations at the same locus and that the new gene designated as *lid* was distinct from and complementary to a majority of other lintless mutants so far reported. This gene has been further studied to find out its linkage relationships with other known genes. The Baroda lintless was crossed for this reason with the white pollen mutant Cocanada 45, the Burma laciniated A8 and a new multiple recessive isolated at this Station from a cross of N6 multiple recessive with Cocanada 45.

The F_1 hybrids were fully dominant for the characters concerned. F_2s and F_3s were grown in the Baroda lintless × A8 crosses and though no F_2s were grown in other two cases, back-crosses to both the parents involved were available for confirming the single factor segregations. The summary of the results is given in Table I.

That the whole of the discrepancy in each one of the cases where χ^2 is significant was due to linkage and not due to any disturbance in the single factor ratios was confirmed by partitioning χ^2 for the three degrees of freedom into its components (Fisher, 1936) when

TABLE I
Two-factor ratios of crosses of Baroda lintless with Cocanada 45, A8 and the New multiple recessive

		Lintless	Linted		Lintless		Total	χ^2	P	Cross-over
			X	x	X	x				
			obs							
Baroda lintless—										
x Cocanada 45 ..	F_2	*Ne–ne*	133	27	33	9	212	4·285	0·3–0·2	
,, ..		*Pb–pb*	137	33	31	11	212	6·096	0·2–0·1	
x New multiple recessive ..	F_2	R_2^{AS}–R_2^{OS}	159	50	53	18	280	0·152	0·99–0·98	
,, ..		*Ya–ya*	155	54	48	23	280	2·197	0·7 0·5	
,, ..		*Ne–ne*	156	53	50	21	280	0·833	0·9–0·8	
,, ..		*Pb–pb*	153	56	48	23	280	2·476	0·5–0·3	
x A8 ..	F_2	L^1–l	199	18	28	45	290	84·866	< 0·01	17·9
,, ..	F_3	,,	207	24	22	54	307	111·519	< 0·01	16·3
										*17·05 ± 1·72
,, ..	F_2	Lc_1^K–lc_1	198	18	29	45	290	83·480	< 0·01	18·3
,, ..	F_3	,,	172	14	23	52	261	121·799	< 0·01	14·8
										*20·46 ± 1·97
		Leaf shape	Narrow		Broad					
,, ..	F_2	Lc_1^K–lc_1	182	35	34	39	290	40·765	< 0·01	27·4
,, ..	F_3	,,	160	36	26	39	261	46·910	< 0·01	26·4
										*26·93 ± 2·28

* Estimate from the combined F_2 and F_3 data.

χ^2 for the linkage degree of freedom alone was found to be very large and significant in all the cases. The results show that the *li*$_d$ gene for lintlessness in the Baroda lintless mutant is linked with the leaf-shape locus with a cross-over value of 17·05 per cent. ± 1·72 and with the lint colour locus with a cross-over value of 20·46 per cent. ± 1·97. The leaf-shape gene is linked with the lint colour gene with a cross-over value of 26·93 per cent. ± 2·28 and confirms the linkage previously reported by Hutchinson (1934) with a cross-over value of approximately 30 per cent. Since the cross-over value of the Baroda lintless gene with either leaf-shape or lint colour gene is nearly equal, the locus of the new gene is somewhere midway between the L and Lc$_1$ genes.

As regards other genes, namely, those for leaf nectaries, pollen colour, petal colour and anthocyanin, the deviations from the expected ratio are not significant and indicate occurrence of free assortment between these and lintlessness.

Economic Botanist,
Baroda, G. K. GOVANDE.
November 18, 1944.

1. Fisher, R. A., "Statistical methods for research workers," 1936, Oliver and Boyd. 2. Govande, G. K., *Curr. Sci.*, 1944 **13**, 15. 3. Hutchinson, J. B., *Journ. Gen.*, 1934, **28**, 437.

CONCENTRATION OF *HEVEA LATEX* BY CREAMING AGENTS

TRAUBE had investigated the efficiency of many vegetable colloids to cream latex and his patent covers all vegetable mucilages in general and specially those extracted from carragheen and Iceland mosses.

The above invention gave an impetus to others to study the creaming efficiency of gum Arabic, gum tragacanth, gum karaya, Algeinic acid, alginates and also materials containing hemicelluloses such as oat, wheat and barley straws; castor, rape, cotton, soya beans, groundnut and linseed meals; bean pods, copra, saw dust, methylated starches; and the gums extracted from certain thickened roots.

Researches by the United States Rubber Company have resulted in the addition to the above list the vegetable colloids obtained from the seeds of plants of several botanical species specially the Leguminosæ.

Experiments on creaming were carried out in the Travancore Rubber Works Laboratory in 1941-42 and it was found that the gums extracted from the leaves and bark of certain plants, specially Laurineæ Sebifera and Malabar Vayana, were able to cream the latex. Since the extraction of the creaming agent from large quantities of plant material was tedious and not practicable commercially further studies were dropped.

The mucilage obtained by cold or hot water extraction of the seed cover of *Trigonella fœnumgrœcum* was noted to cream latex very efficiently. The mucilage was prepared by immersing the seeds for about two days in water, boiling for about two hours and then filtering off the coteledons through cloth. The thick mucilage was mixed with latex of D.R.C. 35 per cent. and the mixture was heated to 50° C. and left undisturbed in a glass jar. Heavy curdling took place in about 30 minutes and in the course of about 6-8 hours cream of D.R.C. 58 per cent. and a lower layer of serum having a D.R.C. 0·2 per cent. were formed. A sample of cream obtained after four days' creaming had a D.R.C. of 63 per cent. This creaming agent is more efficient than the best creaming agent, sodium alginate. The creaming agent looses its colloidal state by keeping for more than four days and is not efficient thereafter. The gum extracted from 1 lb. of the seed is able to cream about 8 gallons of latex. The cream keeps well for months and the traces of creaming agent do not adversely effect the stability of the latex. It can be easily compounded with chemicals to manufacture dipped goods. The creaming agent is not efficient to cream *Cryptostegia latex*.

My thanks are due to Mr. P. R. Narayanan, B.SC., for his assistance; and to the management of the Travancore Rubber Works for the facilities given to me.

New Delhi, A. K. M. PILLAI.
November 1944.

ON A NEW RECORD OF AN INSECT-BORER OF 'AMLA' (*PHYLLANTHUS EMBLICA*, L.)

DAMAGE was done to a number of plants by a moth at Shivajinagar in Poona during August-September 1944. It was observed that a few trees ranging from 1 to 3 feet in circumference were having bored holes in their trunk 2 feet above the ground-level. These holes were 2 to 3 inches deep, measured 0·4 inch in diameter at the openings, and had a silken web covering the entrance.

The observations were done from 15-8-1944 to 15-9-1944. The maximum temperature during this period was 33° C., the minimum 22° C., and the average humidity was 72 per cent. at 11 a.m.

Shiny, black moths, with yellow stripes on the abdomen, and golden yellow marks on the neck, thorax, and wing bases emerged nearly each day between 10 a.m. and 1 p.m. There was no emergence before or after this time. The pupa wriggled up to the entrance and the moth came out through the broken silken covering of the entrance. It was a very sluggish flier and attempts to breed it in the laboratories have failed. It was not traced to breed on any plants in the locality, during or after the above period of observation.

This moth has been identified to be *Paranthrene chrysochloris* Hmpsn. There is no record of the occurrence of this moth on Amla (*Phyllanthus emblica* L.). Amla is a crop of economic importance in our forests, and the importance of its fruits as a great source of vitamin C has been shown by a number of workers (Srinivasan, 1944[1]). It remains to be seen whether this has been noticed doing similar damage elsewhere. I was shown the observations on this very moth on this very tree during the same months and time taken in 1937. I am told by the reliable observer that no such damage was seen, neither this moth observed on this tree between 1937-1944. It thus remains to be seen whether similar gap of time is seen elsewhere in this moth on Amla. It may be suggested that if there are such regular gaps seen, then a periodicity as shown by Roonwal[2] (1944) may be indicated.

I am extremely thankful to Mr. J. C. M. Gardner, Entomologist, Forest Research Institute, Dehra Dun, for the identifications and information. Mr. H. P. Paranjpey, Retired Horticulturist, Poona, very kindly brought the damage to my notice and gave me all help in the observations.

Zoology Department, P. J. DEORAS.
Fergusson College,
Poona 4,
November 23, 1944.

1 *Nature* (38-2), 1944, **153**, 684. 2 *Curr. Sci.*, 1944, **13**, (5), 135.

EVALUATION OF PEPTONE SUITABLE FOR PARENTERAL THERAPY

PEPTONE solution for parenteral administration is generally used for non-specific protein therapy. But it is not known on what compositions of such peptones, the therapeutic efficacy would depend. Accordingly, work in this direction has been undertaken in this laboratory and working with Witte's peptone and its fractionated primary and secondary proteoses prepared by ammonium sulphate precipitation and subsequent dialysis, it is being noticed that both the fractions along with the original whole Witte's peptone solution produce more or less pyrogenic reactions in rabbits. The solutions were all injected intravenously in equivalent doses in terms of nitrogen. The primary proteose fraction, however, gives rise to two distinct type of reactions which can be readily detected. One is an anaphylactoid shock reaction leading to hurried respiration followed by slow stertorous breathing, loss of sphincter control with involuntary micturition and defaecation, and loss of muscle tone developing into a flaccid paralysis of the hind legs. The other type is a hyper-pyrexial reaction causing severe rise in the body temperature (4° F. or more above the normal). It has been found that severity of these two types of reaction vary with the dose of primary fraction injected. Thus, with the higher doses (from 5·0 c.c. to 10 c.c. per kg. ≡ 25 to 50 mgm. nitrogen per kg.) the anaphylactoid reactions become more prominent and the hyper-pyrexial reaction is only a temporary one. But with the lower doses (2·5 c.c. to 5 c.c. per kg. ≡ 12 mgm. to 50 mgm. nitrogen) anaphylactoid reaction is absent, but there is a severe hyper-pyrexial reaction. This hyper-pyrexial reaction, of course, diminishes with the dose and merges into the pyrexial reaction,

which is of course associated with injection of all peptone solutions. In the cases of secondary proteose fraction and Witte's peptone (whole) solution, the reactions obtained are of the usual pyrexial type.

From the antigenicity tests in guineapigs, it is found that none of the fractions gave rise to any anaphylactic sensitization which was, however, invariably produced in animals injected with egg albumin.

Further work is in progress to find out which fraction would be of therapeutic value and what type of reaction could be taken as an index of therapeutic activity so far as its power of leucocytic mobilisation is concerned.

Bengal Immunity Research
Laboratory, Calcutta, S. N. SEN.
November 30, 1944. A. N. BOSE.

A SIMPLE HIGH IMPEDANCE VOLTMETER

DUE to its versatility the vacuum tube in its manifold forms has lent itself to a veriety of circuits for electrical measurements, particularly, of voltages across high impedance sources. The circuit described here was developed in connection with the design of a sound intensity meter by one of us (N. B. B.) for acoustical measurements in the laboratory using a d.c. microammeter which was available as the indicating meter. Fig. 1 shows the circuit employed using a diodepentode tube in rather an unconventional way of preceding the diode part by the pentode stage for which the diode portion along with the indicating meter forms a part of the load. This offers the obvious advantage for a voltmeter circuit which should ideally have an infinite input impedance at all frequencies; the high input impedance of the pentode section is not seriously impaired by the load and its lower input capacitance offers a wider uniform frequency response.

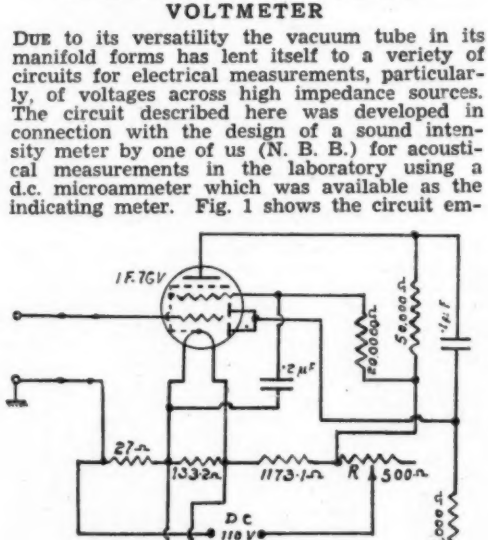


FIG. 1

Fig. 2 shows the calibration curve, using RCA type IF7GV tube, which is a straight line for the whole range; full scale deflection corresponds to an input of about 2·4 volts. Any further increase in the input voltage results in distortion introduced by the pentode

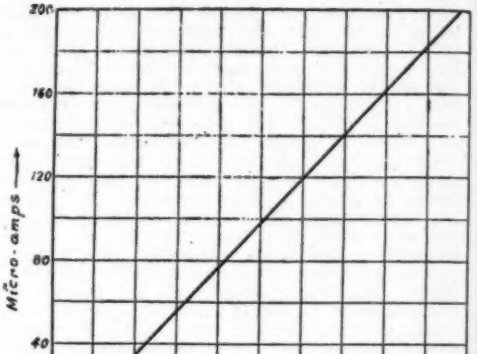


FIG. 2

stage. Hence for higher ranges, multiplier resistances should be used but they must have higher values so as not to bring down the input impedance of the voltmeter. The lower ranges of voltage will necessitate an additional pentode stage for amplification ahead of the voltmeter. Both these can easily be rigged up so that the voltmeter essentially works within the range specified by the curve in Fig. 2, which has been found the same for frequencies between 60 c.p.s and above 10,000 c.p.s.

The instrument is designed to work on 110 volt d.c. supply available in the laboratory but its low current consumption of about 80 m.a. will permit a dry battery operation, if necessary. The switch S (Fig. 1) is provided to check the correct operating voltage across the filament of the tube, which is read on the same meter; this operation simultaneously ensures the correct plate and grid bias voltages. The entire circuit is assembled in an aluminium box 6" × 5" × 4" in overall dimensions. Besides the switch the only control on the panel is a potentiometer which controls the supply voltage.

Recently T. A. Ledward has desecribed a voltmeter (*Wireless World*, Vol. L, 162, 1944 June) employing a similar idea using two diode-pentode tubes in a bridge circuit for essentially the same performance offered by the much simpler circuit described here with its modest demands on components, power consumption and attention.

Electroacoustics,
Dept. of Electrical Technology,
Indian Institute of Science,
Bangalore, N. B. BHATT.
December 14, 1944. B. SUBRAMANIAN.

REVIEWS

Flood Estimation and Control. By B. D. Richards, B.Sc., M.Inst.C.E. (Chapman and Hall, Ltd., 11, Henrietta Street, London, W.C. 2), 1944. Pp. 152. Price 16s. net.

To those interested in floods and especially the relationship between rainfall and run-off, this very clearly written book by B. D. Richards will be most helpful. The various factors which affect run-off and their relative effects are considered mathematically, basing the intensity of flood discharges on the period of concentration and the reduction of intensity of flood contributed by each part of a catchment as a result of the damping effect of the various factors, and he shows how to work out the maximum discharge by making assumptions and he also works out the percentage error likely to result from errors in each assumption. Rainfall intensity is a function of both time and area, and run-off is affected by the size, direction of movement, distribution and duration of storms, the area of the catchment, its shape, slope, initial state of wetness and coefficient of run-off—which is dependent on the nature of the catchment. These he calls the six major factors affecting floods; but their relative importance varies widely.

The mathematical treatment, which is easy to follow, is both interesting and instructive. It brings out clearly the fact that our prediction of storms must depend mainly on experience and data applicable to areas with similar characteristics. In those parts of India where heavy storms occur, we can, to a large extent neglect wetness of catchment and slope, and even the catchment characteristics—i.e., whether afforested, cropped, or bare—because these make little difference under cloud-burst conditions, especially in the case of fan-shaped catchments, when area becomes the predominant factor. Consequently in India formulas of the type Run-off $= CP^n$ are widely used—where P is weighted mean precipitation and n is an exponent varying in different formulas from $\frac{1}{2}$ to $\frac{2}{3}$. In catchments which differ considerably from fan-pattern, it is necessary to take shape into account, because it affects the time of concentration and may be a very important factor. The area of storms relative to the catchment area and the direction of movement are also important in India in the case of large catchments.

The author, who used to be in India but is now working in England, has written the book to cover conditions in Britain, where storms are relatively restricted in area and rainfall generally much less intense than in India.

Under such conditions assumptions must necessarily be widely different from those in India; but it is probable that even in Britain a formula of the simple type [Annual Run-off in inches $= C(P - 12'')$] will be found useful. In the Western Ghats of India, where the rainfall is 100" to 300" in three months, $C = \cdot 85$.

Flood control by storages and the effect of soil erosion on the regime of rivers are dealt with briefly but adequately. The print and illustrations are exceptionally clear. The book opens wide and remains open where desired. In fact the publishers deserve great credit for the production.

C. C. INGLIS.

The Fortunes of Primitive Tribes. By D. N. Majumdar. (The Universal Publishers Ltd., Lucknow), 1944. Price Rs. 12.

Dr. D. N. Majumdar undertook an ethnographic, anthropometric and blood group survey of the United Provinces at the time of the Census operations in 1941. The results are now being worked out, the volume before us being the first of the four volumes projected. Mr. Bhagvan Sahay, I.C.S., Superintendent of Census Operations, Dr. Majumdar and the authorities of the Lucknow University, deserve the thanks of all anthropologists in and outside India for making available to them these full accounts of several cis-Himalayan tribes about whom our information is so meagre. Comparisons are to be avoided in a review, but the reviewer cannot resist the temptation to compare the anthropological results of other provincial surveys to those of the United Provinces and point out that whereas the former are either nil or ridiculously inadequate or amateurish, the latter are as sumptuous as one would wish. Anthropologists have been asking in the past for the establishment of a permanent ethnographic survey of India associated with a permanent census bureau on the American model, but in the absence of such an ethnographic establishment, what the U.P. Government have done is the second best arrangement. Dr. Majumdar is well-known to the readers of *Current Science*, so that there is little need for the reviewer to go into details regarding the quality of his work. In an introductory chapter, Dr. Majumdar explains the implications of the race concept and its application to Indian communities. In the following chapters, the ethnology, bodily characters and blood groups of the Korwas, the Tharus and the Khasiyas are discussed. Brief descriptions are given of a few of the numerous criminal tribes of the Province. The most important chapter is the last one on "Tribal Cultures and Social Vigilance" wherein the psychology of culture change and adaptation is considered with great insight. A word of praise is due to the publishers who have managed, in spite of war-time difficulties, to render the volume artistically pleasing.

A. AIYAPPAN.

RECENT ADVANCES IN BIOCHEMISTRY*

THE present war has provided a powerful incentive to greater endeavour in certain fields of research, represented by physiology, general biochemistry, nutrition and medicine. Wider opportunities, greater variety of research material not ordinarily available, ungrudging and generous financial support and increasing State recognition and public appreciation of the indispensability of science for modern warfare, these factors have conspired to accelerate the progress of certain branches of science, which the world has been witnessing to-day. The fruits of these intensive labours carried out in laboratories of the belligerent Nations, are partially reflected in the Annual Reviews of Biochemistry. Much of the work must, for strategic reasons, await the return of peace while a substantial portion of the research published in the axis countries is not easily accessible.

In spite of these circumstances, the review for the year 1944 continues to portray a steady record of progress in the field of Biochemistry. Of the twenty-six topics discussed in the volume, no less than twenty-two are reviewed by American investigators, a significant circumstance which is indicative of the fact that to-day, the United States offers the most propitious and the most serene atmosphere for the prosecution of scientific research and for the promotion of scientific thought.

Biological oxidation and reduction has been reviewed by D. E. Green who has made substantial contributions to this field. The position of iron porphyrin enzyme complexes has been clarified and reference has been made to the possibly close relationship of flavoprotein systems with antibacterial agents. Two more coenzymes, different from any so far known, associated with lysine decarboxylase and aspartic transaminase systems, have been described. The physiological significance of acetyl phosphate discovered by Lipmann has been further elucidated. The author has discussed the citric acid cycle of Krebs in the light of recent work. The non-oxidative enzymes are reviewed by The Manns who have given a stimulating review of the eleven enzyme complexes of established integrity engaged in carbohydrate metabolism. Special attention should be drawn to the enzyme-like diffusing factors which are coming into prominence. The enzymes concerned with the utilisation, liberation and transport of CO_2 have received adequate attention.

The recent methods of the isolation and determination of amino acids in protein hydrolysates, are reviewed by Neurath and Greenstein. This includes the promising chromatographic and microbiological methods of separation and estimation as also the methods of isotopic analysis. A new and fruitful departure is the estimation of certain amino acids on intact protein without hydrolysing it. This procedure is obviously of fundamental value in elucidating the nature of the reactive groups determining its biochemical activity.

The chemistry and metabolism of the compounds of phosphorus is the topic of a detailed review by Green and Colowick. The field of carbohydrate, fat and protein metabolisms are as usual covered by three separate reviews. Indications that certain amino acids may eventually prove to be the precursors of certain vitamins in their biological syntheses are gradually unfolding themselves. The action of certain powerful drugs like sulphanilamides on biochemical reactions potentiated by enzymes and vitamins are discussed in the review on Water-Soluble Vitamins. Evidence regarding the existence of two more fat-soluble vitamins are presented in the review on Fat-Soluble Vitamins. One of them whose deficiency causes wrist stiffness and which is associated with raw cream has been obtained in a concentrated form.

The nutritional deficiencies in Farm Mammals is a subject of topical interest in view of the post-war restocking and breeding of herds which have been slaughtered or destroyed. It is of particular interest to India where the nutritional status of our stocks are depressingly poor, and where the "infant" mortality among our calves is appallingly high (50 per cent.). This topic forms the subject of an instructive review by Huffman and Duncan.

Biochemistry of fungi has been reviewed from a new and stimulating angle. "In the light of recent research showing that certain biochemical activities of the mold *Neurospora* are controlled by specific genes, it seems reasonable that similar genetic controls are responsible for many of the varied biochemical avtivities of fungi." The review represents a praiseworthy attempt at correlating recent developments in the biochemistry of fungi with this general concept.

David Glick who is a well-known figure in the field of micro- and ultramicro-chemistry, contributes a comprehensive and valuable review on histochemistry. Other reviews include those pertaining to Chloroplast Pigments, by H. H. Strain; Mineral Nutrition of Plants, by F. J. Richards; Growth-Regulating Substances in Plants, by J. Van Overbeek; Photoperiodism in Plants, by Karl C. Hamner; Synthetic Drugs—Antispasmodics, by F. F. Blicke; Alkaloids, by R. H. F. Manske; Chemistry of Harmones, by H. Jensen; Mineral Metabolism, by McCance and Widdowson; Biochemistry of Nucleic Acids, by Loring; and Steroids, by Koch.

The standard of the *Review* to which readers all the world over are accustomed has been maintained and Dr. Luck, the Founder-Editor, deserves the gratitude of all investigators in the field of Biochemistry to whom the Review continues to offer an unfailing source of stimulus and inspiration.

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* Annual Review of Biochemistry, Vol. XIII, Edited by James Murray Luck and J. H. C. Smith (Annual Reviews, Inc., California), 1944, pp. ix+795. Price $5·00.

DRY FARMING IN INDIA*

OVER large parts of India, the greater proportion of crop production is solely dependent upon the sufficiency and effectiveness of the monsoon rains. Unfortunately, in many tracts, particularly in Bombay, Madras and the Punjab, and in the States of Rajputana, Hyderabad and Mysore, the annual rainfall is not only uncertain in quantity but also often badly distributed as regards crop requirements throughout the year. This condition results in frequent crop failures leading to periodic scarcities and famines. The problem of preventing crop failures in these 'scarcity' tracts is of a twofold nature. In the first place, it becomes necessary to work out a scientific system of dry farming whereby crops can be grown with a fair measure of success in years in which the annual rainfall is low and precarious. Secondly, the immense losses of the cultivator's main capital, the soil, which result from the continuous erosion by rain-water after heavy and untimely precipitations, must be checked and necessary measures taken to prevent such run-off and erosion.

Scientific research into the problems of dry farming has occupied the attention of agricultural scientists for many years and in all parts of the world. In India, a systematic approach to the problem was made possible only about a decade ago when the Imperial Council of Agricultural Research initiated certain co-ordinated schemes of research on the subject in the different provinces of Bombay, Madras, Hyderabad and the Punjab. The Bombay scheme was started in 1933 at Sholapur and Bijapur, centres of famine tract. The work at Madras was started at Hagari near Bellary in 1934 and, in the Hyderabad State, at Raichur also in that year. The Punjab scheme was carried out at Rohtak from 1935. The publication under review presents a critical account of all the data and of the results which have so far emerged from the work of these five Dry Farming Research Stations in the country.

The five experimental stations represent two rather widely different tracts in India which are the 'problem areas'. Rohtak is typical of the northern dry zone while the four stations in the south represent the great plateau of peninsular India. The results of the investigations reported in this publication can, therefore, be conveniently reviewed separately for the two areas.

The scarcity tract of Northern India consists of extensive alluvial plains comprising parts of the Punjab, Rajputana, Sind and the North-West Frontier Province. The rainfall is usually low, is characterized by long breaks and is mostly received from the south-west monsoon during the three months from July to September. The climate is desiccating, due to high temperatures, even during the monsoon months. The soils are alluvial in origin and consist of level plains with great depths; on account of their porous character, even small showers of rain are absorbed and the water penetrates easily to lower depths. Soil erosion by rain-water is not, therefore, very serious in this tract although, in some places, wind erosion is met with. The dry farming problem of this tract is thus principally one of conserving soil moisture.

The findings of the investigations at Rohtak indicate that this water problem can be effectively tackled and crops secured by (*a*) bunding of the land and division into compartments, (*b*) shallow ploughing after the first rains, (*c*) repeated shallow ploughing, during breaks in the monsoon, by *sohaging* (i.e., compacting of the soil with a wooden implement of *sohag*) till the sowing of the *bajri* or *guara*, (*d*) wider and thinner sowing, (*e*) addition of farmyard manure, (*f*) mulching by repeated inter-culture, and (*g*) keeping a part of the land fallow for a full year and taking a crop in the following year.

The scarcity area in the south presents, however, a more difficult problem. It consists of an extensive plateau comprising parts of Bombay, Hyderabad and Madras. The average annual rainfall of this area is somewhat higher than that in the scarcity areas of the north although it is equally precarious. The rainy period extends over a longer period of five months from June to October. The rainfall in September and October is higher and consists of heavy showers. On account of undulating topography and the rather impervious nature of the heavy clay soil, mostly of basaltic origin, a large part of the annual rainfall is lost by surface run-off which brings in its wake the more serious loss, by erosion, of the cultivable soil mantle, *viz.*, the loose, friable, surface soil. The dry farming problem of this tract is, therefore, twofold: the prevention of the loss of rain-water by run-off and the control of soil erosion.

Agronomic experiments are reported in the publication to demonstrate that, even in seasons when the rains prove scanty and untimely, crops can be grown successfully by simple and inexpensive modifications in the existing technique of cultivation as practised by the local agriculturists. The results of these investigations have been embodied in what is designated here as the Bombay Dry Farming Method which is a simple system of land preparation, tillage and crop cultivation designed with the aforesaid objects of conserving soil moisture and preventing surface wash. The main features involved in the Bombay Dry Farming System are (*a*) simple field bunding along the contours of the cultivated areas, (*b*) modifications in the local agricultural practices in connection with ploughing and harrowing of the land, sowing of the seed and inter-culturing the growing young crops, (*c*) the extension of manuring, especially green manuring, (*d*) the introduction of scientific methods of crop rotation and of judicious fallowing of cultivable fields, and (*e*) the cultivation of drought-resistant varieties of the major crops. It is claimed that the proposed method is simple, practicable and economically sound. It has given at least fifty per cent. more income than the preva-

* *Dry Farming in India*, by N. V. Kanitkar (Scientific Monograph No. 15, The Imperial Council of Agricultural Research, The Manager of Publications, Delhi), 1944, pp. 352, Price: Rs. 13-12-0 or 21 h. 6 d.

lent cultivators' method when tested on their own fields over a period of seven years.

As the book is essentially a record of the research work carried out at the five experimental stations, it may be contended that it is not a monograph in the strict sense of the word. Doubtless, there are scientific aspects of dry farming which require further study although at present the greater need would appear to be for the widespread adoption, with such local modifications as may be necessary, of the principles and techniques now revealed.

A. SREENIVASAN.

SCIENCE NOTES AND NEWS

POST-WAR RECONSTRUCTION PROGRAMME FOR TRAVANCORE

Travancore has made a praiseworthy start indeed with a succinctly laid out programme outlined in the address by the Dewan Sachivothama Sir C. P. Ramaswamy Iyer to the first meeting of the Post-War Reconstruction Committee. Announcing that Rs. 7 crores will be made available over a period of three years, the Dewan said, "Transport, Canal Traffic, Coastal Shipping, Production of Power, Fertilisers and Cottage Industries—you must embark upon these, whether there is gain or not, but the other industries such as ceramics and rayon, or what may be called semi-luxury industries, on which there will be tremendous competition, will take a secondary place only". Stressing upon the fact that efficient transport is the first desideratum for post-war development, the Dewan has proposed schemes for a large outlay on Roads, including cement concreting them, the opening of a cement factory with the co-operation of the powerful Associated Cement Company, manufacture of types in the Rubber Factory in co-operation with Messrs. The Dunlop and Company, improvements of the extensive canal routes by deepening them and strengthening the banks, and for a State-controlled coastal shipping service in agreement with the Scindia Steam Navigation Company. Rs. 16 lakhs have already been allotted for the restoration of the A.V.M. and other canals between Alleppey and Trivandrum. Additional developments of the Hydroelectric power resources in the Pallivasal and Periyar areas are also necessary.

"The manufacture of fertilisers is another industry that cannot wait." The Travancore Chemicals and Fertilisers, with a capital of Rs. 5 crores, has already drawn up agreements with the Government of Madras, the Government of India and with the suppliers of machinery so that the Factory can begin work in the very near future.

One of the biggest post-war schemes should tackle the very important question of cottage industries, in order to improve the condition of the peasants. There should be a survey of the possible cottage industries, and a concentration on those which can be taken up immediately on a co-operative basis or otherwise, and with gain, under the conditions prevailing in Travancore. The Government will be prepared to subsidise and give advances in the early stages.

Programmes for forest conservation, and for efficient utilisation of timber and soft-wood for the plywood industry, and a protected plastics industry are also required. Great progress has already been made with the Aluminium Industry, the Glass Works, and the Ceramic Factory, but further developments for their continued and successful working in a keenly competitive post-war world, must be formulated. Fisheries are another great asset to Travancore, and a flourishing research backed by Fisheries Department is a great necessity.

The address is replete with concrete and practical suggestions for programming, and we wish Travancore God-speed in all these schemes, which are after all but modest and none too ambitious, and should, therefore, be realisable according to expectations. M. A. G. RAU.

The Maharaja of Travancore Lord Curzon Prize of the *University of Madras*, "for the most meritorious original investigations in the physical sciences (Chemistry)" has been awarded this year to Mr. S. Rajagopalan, M.SC. (of the Indian Institute of Science), for his thesis on "Essays in Chemotherapeutical Synthesis".

The Joint Annual Meeting of the Indian Academy of Sciences and of the National Academy of Sciences will be held at Poona from Wednesday, the 27th December 1944, to Saturday, December 30th, 1944, at the Fergusson College. The session will be inaugurated by the Rt.-Hon. Dr. M. R. Jayakar. Sir C. V. Raman will deliver the presidential address to the Indian Academy of Sciences, which will be followed by a symposium on "The physics of the upper air" to be opened by Dr. K. R. Ramanathan. In the afternoon a symposium on "The Chemistry, Pharmacology and Therapeutics of Sulphonamides" will be led by Lt.-Col. S. S. Sokhey. The second day's proceedings include a discussion in Magnesium in Relation to Structure led by Prof. Krishnan and the presidential address to the National Academy of Sciences which will be delivered by Prof. Birbal Sahni. A symposium on "The age of the saline series of the salt range of the Punjab" will be held on the third day under the chairmanship of Prof. Sahni. The rest of the programme includes the reading of original papers, public lectures and excursions.

Dr. C. N. Acharya has received the D.Sc. of the London University for his work on the preparation of composts.

JUBILEE CONVOCATION OF THE PATNA UNIVERSITY AWARD OF HONORARY DEGREES

On the occasion of the Jubilee Celebrations, honorary Doctorates were conferred on seven-

teen eminent scholars of the country, distinguished for their contributions to the various branches of human knowledge. In the course of presenting these learned personages to the Chancellor, Sachchidananda Sinha, the Vice-Chancellor of the University, referred to the recipients as follows:—

SIR TEJ BAHADUR SAPRU.—"One of the most distinguished of our elder statesmen and one of the most eminent publicists; also a lawyer and jurist of great reputation, honoured wherever learning and character are honoured." (LL.D.)

SIR MAURICE GWYER.—The first Chief Justice of India, "who in that capacity established a great tradition of scholarship and fairmindedness and whose remarkable gifts of organisation, tact and learning are now devoted to the cause of education as the Academic Head of the Delhi University." (LL.D.)

KHWAJA SIR MOHAMMAD NOOR.—"For long a leading figure in Bihar's public life, as a firm and tactful President of the Legislature, an able, independent and upright Judge, and a successful Vice-Chancellor of the Patna University." (LL.D.)

SIR SARVAPALLI RADHAKRISHNAN, Professor at Calcutta and Oxford.—"The most brilliant exponent of Indian Philosophy, and an original thinker, who has been the academic head of the Andhra University, and is now Vice-Chancellor of the Benares Hindu University, whose reputation as a scholar and thinker, is international." (D.LITT.)

SIR JADUNATH SARKAR "who was for many years professor at Patna, one of the most eminent of India's historians and unquestioned authority on the Indo-Mughal period". (D.LITT.)

DR. AMARNATH JHA, Vice-Chancellor of the Allahabad University.—"A most distinguished scholar of English language and a well-known authority on the development of English literature, who has now been for over fifteen years the Head of the English Department of the Allahabad University, and who, though a son of Bihar, has done his work so far in the United Provinces." (D.LITT.)

SIR JOHN SARGENT, Educational Advisor to the Government of India, who is responsible for the monumental scheme for educational reconstruction, which reveals his liberal and sympathetic outlook, and his firm faith in the educational future of the country. (D.LITT.)

DR. JOHN MATTHAI, one of the foremost Economists, who is now head of the great firm of The Tatas, and is as such closely associated with plans for the economic industrial development of the country. (D.LITT.)

MR. DEBENDRANATH SEN, "a veteran educationist, who for many years was head of one of the leading Colleges of Patna, and who is held in high regard by his colleagues and by several generations of students". (D.LITT.)

SIR VENKATA RAMAN, who is an international figure in Physics, being one of the outstanding authorities on Optics. He gave up a promising career in Government Service, and has dedicated himself since with enthusiasm and singleminded devotion to the cause of scientific research. He has built up a remarkable school of Physical investigators, who have distinguished themselves far and wide, and to discovery of the rays known after his name has been of incalculable value. Since the death of Rabindranath Tagore he is the only Indian Nobel Laureate. (D.Sc.)

SIR MOKSHAGUNDAM VISVESVARAYA.—"A great and distinguished Engineer, and an eminent administrator, old in years but young in spirits. He is a unique figure in our public life, who is held in universal esteem for his high character and his constructive genius. He is an ex-Dewan of Mysore, which owes much of its prosperity to his administrative ability and engineering skill." (D.Sc.)

DR. SIR ZIAUDDIN AHMAD, who has long been an outstanding educationist, a Member of the Calcutta University Commission, a distinguished mathematician, the academic head of the Aligarh Muslim University, and a prominent figure in the Central Assembly, where he is regarded as an expert on railway questions and affairs. He is an authority on systems of examination in various countries. (D.Sc.)

DR. LAKSHMANASWAMI MUDALIAR, "who has a recognised position among the leading physicians of the country. His great abilities are now devoted to the Madras University, of which he is the academic head, but he had also made great and valuable contributions to various branches of medical science". (D.Sc.)

DR. PROF. BIRBAL SAHNI, "who has been a Professor of Botany at Benares, Lahore and Lucknow. Himself an eminent botanist and geologist, he is also the founder of a school of research. His work in Fossil Botany has been of very great importance and the results of his researches have been widely appreciated." (D.Sc)

DR. HOMI BHABHA, "who though young in years, has already attained a position of eminence by his brilliant researches on the cosmic rays. He is not only a scientist of distinction, but is a person of versatile gifts and rare powers of exposition. Of the living Indian scientists he obtained the much-coveted distinction of F.R.S. at the early age of thirty-two". (D.Sc.)

PROF. PRAN KRISHNA PARIJA, a well-known botanist, who has for several years been connected with this University, and is now the academic head of the Utkal University. He occupies a prominent position among botanists in this country. (D.Sc.)

DR. SIR SHANTISWARUP BHATNAGAR, "on whom the degree of DOCTOR OF SCIENCE was conferred *in absentia*".

MAGNETIC NOTES

Magnetic conditions during November 1944 were slightly less disturbed than in the previous month. There were 19 *quiet* days and 11 days of *slight* disturbance, as against 10 quiet days, 18 days of slight disturbance and 2 days of moderate disturbance during the same month last year.

The quietest day during the month was the 13th and the day of the largest disturbance the 10th.

The individual days during the month were classified as shown below;—

Quiet days	Disturbed days	
	Slight	
1, 2 7, 8, 11–17, 19, 21–25 29, 30.	3–6, 9, 10, 18, 20 26–28.	

No magnetic storms occurred during the months of November in the years 1943 and 1944.

The mean character figure for the month of November 1944 was 0·37 as against 0·73 for November last lear. M. PANDURANGA RAO.

SEISMOLOGICAL NOTES

Among the earthquake shocks recorded by the seismographs in the Colaba Observatory during the month of November 1944, there were five of slight and three of moderate intensities. The details for those shocks are given in the following table:—

Date	Intensity of shock	Time of origin I.S.T.	Epicentral distance from Bombay	Co-ordinates of epicentre	Depth of focus	Remarks
		H. M.	(Miles)		(Miles)	
6	Slight	02 26	900			
6	Moderate	12 19	1005			
11	Slight	09 51	1005			
15	Slight	05 48	1270		140	
16	Moderate	03 17	3760			Epc.: Near Philipine Islands.
16	Moderate	18 42	5765			
23	Slight	17 33	1035			
24	Slight	11 22	5505		125	Epc.: Probably near New Britain.

We acknowledge with thanks receipt of the following:—

"Journal of the Royal Society of Arts," Vol. 92, Nos. 4675 and 4677.
"Journal of Agricultural Research," Vol. 68, No. 11; Vol. 69, Nos. 2-3.
"Agricultural Gazette of New South Wales," Vol. 55, Pts. 8-10.
"Indian Journal of Agricultural Science," Vol. 13, Pt. 3; Vol. 14, Pt. 1.
"Biological Reviews," Vol. 19, No. 3.
"Biochemical Journal," Vol. 38, No. 3.
"Calcutta Review," Vol. 99, Nos. 2 and 3.
"Journal of the Indian Chemical Society," Vol. 21, No. 7.
"Journal of Chemical Physics," Vol. 12, Nos. 7 and 9.
"Discovery," Vol. 5, Nos. 9-10.
"Indian Farming," Vol. 5, No. 5.
"Transactions of the Faraday Society," Vol. 15, Nos. 9-10.
"Indian Forester," Vol. 70, Nos. 9-11.
"Genetics," Vol. 29, No. 5.
"The Quarterly Journal of the Geological, Mining and Metallurgical Society of India," Vol. 16, No. 2.
"Horticultural Abstracts," Vol. 14, No. 3.
"Central Board of Irrigation Bulletin," Vol. 1, No. 5.
"Bulletin of the Indian Central Jute Committee," Vol. 7, Nos. 7-8.
"Mathematics Student," Vol. 12, Nos. 1-2.
"Indian Medical Gazette," Vol. 79, No. 10.
"The Review of Applied Mycology," Vol. 23, Nos. 8-9.
"Bulletin of the American Meteorological Society," Vol. 25, No. 6.
"Journal of Nutrition," Vol. 28, No. 1.
"Nature," Vol. 154, Nos. 3909-3913.
"Indian Journal of Physics," Vol. 18, No. 2.
"Journal of Research of the National Bureau of Standards," Vol. 32, No. 5; Vol. 33, No. 1.
"Science," Vol. 100, Nos. 2584, 2590, 2591-96.
"Scripta Mathematica," Vol. 9, No. 4.
"Science and Culture," Vol. 10, Nos. 5-6.
"Journal of Scientific and Industrial Research," Vol. 3, Nos. 4-5.
"Monthly Science News," Nos. 37-39.
"Sky," Vol. 3, No. 11.
"Indian Trade Journal," Vol. 155, Nos. 2002 to 2008.

BOOKS

Principles of Physical Geology. By Arthur Holmes. (Thomas Nelson & Sons Ltd., Parkside Works, Edinburgh 9), 1944. Pp. 532. Price 30/-.

Sex Education—A guide for parents, teachers and youth leaders. (Messrs. Macmillan & Co., Ltd., London, W.C. 2), 1944. Pp. 290. Price 7/6.

Radio Receivers and Transmitters. By S. W. Amos and F. W. Kellaway. (Chapman & Hall Ltd.), 1944. Pp. 281. Price 21/-.

CORRECTIONS

Vol. 13, No. 11 (November 1944)

Article entitled "Role of Domestic Animals in the Spread of Helminthic Infections in Man"—

Page 274, column 2, line 40: read *Diphyllobothrium* for *diphyllabothrium*; line 49: read *Dipylidium* for *Diphylidium*.

Page 275, column 2, line 16: *read* recorded *for* reecorded.

Page 276, column 1, line 25: *read* sources of infection *for* source of infections.

Article entitled "Production of Light-Effect Under X-Rays"—

Page 278, Heading of the note: *read* Light-Effect *for* Eigat-Effect.

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A Divali scene four years ago

The illuminations at Divali are normally a part and parcel of Indian life. Candles are a prominent feature of these celebrations. In the past their availability was taken for granted. But the modern candle is made from petroleum wax, which today is playing its part along with other products of petroleum in the war effort of the United Nations.

So for some time past, we have gone short of candles, plain and coloured, common and decorative, bought for everyday use or for special occasions like Divali. It is hoped shortly to make more candles available in certain sizes, and users can rest assured that as soon as possible Burmah-Shell will again put on sale its full range of candles to suit every need and occasion.

INSERTED BY BURMAH-SHELL

The Bangalore Press